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BASED ON OFFICIAL MANUALS

EDITED BY CAPT. E. J. SOLANO

FIELD ENTRENCHMENTS

SPADEWORK FOR RIFLEMEN

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Written by an Engineer Officer attached to the Imperial General Staff

AND EDITED BY

CAPTAIN E. J. SOLANO

LONDON
JOHN MURRAY, ALBEMARLE STREET, W.
1916

First Edition, *November*, 1914
Reprinted . *November*, 1914
Reprinted . *November*, 1914
Second Edition, *January*, 1915
Reprinted . . *January*, 1915
Reprinted . . *January*, 1915
Reprinted . . *March*, 1915
Reprinted . . *May*, 1915
Reprinted . . *July*, 1915
Reprinted . *February*, 1916
Reprinted . . *April*, 1916

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INTRODUCTION

I HAVE been asked to write a few words of introduction to this book on Field Entrenchments. The writer, who prefers to remain anonymous, has concentrated on this subject something like twenty years of practical study, acquired partly during the whole of the South African War, in which he gained distinction, partly by close observation of the battlefields of Manchuria, partly by years spent in training cadets, and as an officer in command of a field company of Royal Engineers. I have known him since he joined as a young officer at the School of Military Engineering, where I was then an Instructor, some twenty years ago, and I can confidently say that there is no one who knows the subject better, or more able than he is, to impart to others the knowledge he has acquired.

This work is based, therefore, not on the armchair theories of the student, but on the stern realities of war. Its value has been exemplified in a startling manner during the present colossal strife in North-East France.

The book discusses the field work of the spade in its true relation to tactics. I do not know of any important points that are omitted, though possibly the experience of the present campaign may add some new matter for consideration and cause us to modify others. In one particular—namely, in the use of sapping where two entrenched lines be opposite each other, and manœuvring is impossible—the

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teaching in this book has anticipated the present operations.

There is nothing pedantic, nothing superior about the work. While the application of its teaching must be left to individual resource and energy, the knowledge contained in it should enable any officer to instruct his men, under varied conditions of warfare, in an art which has become more and more vital to the many, and no longer the science of the few.

G. K. SCOTT-MONCRIEFF,
MAJOR-GENERAL,
Director of Fortifications and Works.

October 18, 1914.

ACKNOWLEDGMENT

THE editor desires to express his thanks and acknowledgments to the Military Authorities and to His Majesty's Stationery Office for permission to reproduce illustrations and extracts from the Manuals of Field Engineering and Military Engineering, and Infantry Training, 1914. It is intended to keep each edition of this book abreast of the latest developments in the science with which it deals and the changes made from time to time in the official training manuals.

E. JOHN SOLANO,

LONDON,
1914.

AUTHOR'S NOTE

THE history of warfare teaches us that without men imbued with the spirit of offence, the machine, the textbook, the weapon, the spade, and the fortification, cannot ensure victory; that immobility of men or methods alike results in disaster, and that the massive fortification is but the head of a nail the point of which lies near the heart of the defender awaiting the enemy's hammer to drive it home.

Thus it is not in the spirit of the fox going to earth, but that of the huntsman digging him out in the presence of the expectant pack that the Rifleman is invited to study these notes on Spadework in the Field. The Author wishes to express his gratitude to Mr. E. J. Solano, to whose enterprise and valuable co-operation it is due that this book is now published.

NOTES FROM EXPERIENCE GAINED AT THE FRONT

In Appendix VIII. of this book, valuable information based on experience gained at the front has been added, to which reference must be made in reading the book. This information does not change the general principles of training laid down in the book. It merely gives the benefit of experience in applying these principles to the conditions which have so far prevailed in the course of the campaign on the Continent.

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FIELD ENTRENCHMENTS

SPADEWORK FOR RIFLEMEN

CHAPTER I

INTRODUCTION

I.—General Information.

Types of Fortifications.—Fortification is usually classified under three headings—namely, Permanent, Provisional, and Field. The difference between these three types is based upon two principal factors. Firstly, the time elapsing between their construction and probable use; and, secondly, the resources devoted to their construction.

Permanent Fortification.—Permanent fortification implies defensive measures of the most complete nature, and includes works designed and constructed in peace-time with all the advantages which can be derived from ample time, the employment of the best civil labour, and all the resources of science. Such fortifications are only applied to important strategical points on land and sea, such as frontier-lines, harbours, dockyards, arsenals, and important points on lines of communication.

Provisional Fortification includes works designed and sited in peace, but constructed in immediate anticipation of war or during war at points of strategical or tactical importance.

Field Fortification.—By field fortification is implied all those measures which may be taken for the defence of positions intended to be held only temporarily. Works of this kind are executed either in face of the enemy or in immediate anticipation of his approach. Field fortification presupposes a defensive attitude, and, though recourse to it may under certain circumstances be desirable, *it must always be regarded as a means to an end, and not an end in itself.*

Object of Field Fortification.—The principal aim of field fortification or entrenchment is *to enable the soldier to use his weapons with the greatest effect*, the second to protect him against the adversary's fire. By thus reducing losses and increasing the powers of resistance in one part of the theatre of operations or field of battle, more troops are available to swell the force destined for decisive action there or elsewhere. The extent to which field fortification is employed will depend on whether a commander acts on the offensive at the commencement of an action, or whether he prepares to await attack in the first instance.

Field Works in Attack.—*The main essential to success in battle is to close with the enemy, cost what it may.* A determined and steady advance lowers the fighting spirit of the enemy, and lessens the accuracy of his fire. Hesitation and delay in the attack have the opposite effect. *The object of infantry in attack is therefore to get to close quarters as quickly as possible*, and the leading lines must not delay the advance by halting to fire until compelled by the enemy to do so. Accordingly in attack field fortification will find only a limited application. As regards entrenching, *Infantry Training*, 1914, lays down that *infantry in attack must not delay the advance or diminish the volume of fire by entrenching.* Entrenchments in the attack are only resorted to when, owing to farther advance being impossible, the efforts of the attacking force must be limited temporarily to holding the ground already won. *The advance must be resumed at*

the first possible moment, even though it be necessary to dig continuous covered paths right into the enemy's lines.

Fortification of Tactical Points.—All important tactical points captured in the attack should at once be put in a state of defence, so that attempts on the part of the enemy to recapture them may be defeated, and they may serve as supporting points to the attack. Local reserves will often find opportunities for strengthening localities or fire positions which have been gained previously by the firing-line. Detachments of engineer field companies may be attached to them to assist in such work.

Field Works in Defence.—In defence the amount of work to be undertaken will depend on the object, the ground, the time, and the numbers of men and tools available. Defensive tactics in which infantry are employed differ according to the object in view. In *Active Defence* the ultimate object is to create and seize a favourable opportunity for a decisive offensive. In *Passive Defence* the object is to beat off an attack without hope of being able to turn the tables on the enemy by assuming the offensive at some stage of the fight—as, for example, in the defence of an isolated fortified post weakly garrisoned. Defensive tactics include the *Delaying Action*, the object of which is to gain time by means of manœuvre without risking defeat, such as the work of rearguards, or when awaiting the arrival of reinforcements.

In connection with defensive tactics it must be remembered that the defenders cannot hope to obtain decisive results unless they are able ultimately to turn defence into offence. *No natural or artificial strength of position will of itself compensate for loss of initiative when an enemy has time and liberty to manœuvre. The choice of a position and its preparation must therefore be made with a view to economize the power expended on defence in order that the power of offence may be increased*

Distribution of the Defending Force.—The troops will be divided into two main portions — one, known as the "general reserve," to be held in readiness for the initiation of a general offensive when a favourable opportunity has been created, the other to create the desired opportunity by temporarily taking up a defensive position, and then to co-operate actively with the general reserve in the attack on the enemy.

Defensive Positions. — The ground occupied in an extended defensive position will usually be forced upon the commander by circumstances beyond his control, but may often include a number of localities or firing-points of special tactical importance. The efforts of the defender will be directed in the first instance to occupying and securing these points, so that they may form pivots upon which to hinge the defence of the remainder of the position.

The object with which a position is occupied as well as the time likely to be available for its preparation will usually determine the works to be undertaken, but, as no position can ever be too strong, additions and improvements should continue to be made up to the last moment. Such improvements are not to be confined to the provision of better cover from fire for the defenders. Special consideration must also be given to the means by which the artillery will co-operate with the infantry.

In practically all positions there will be localities of special tactical importance. It is on localities of this nature that the principal efforts of the defender should be concentrated in order that they may form pivots on which to hinge the defence of the rest of the position. They may be commanding features of the ground, groups of substantial buildings and enclosures, or wooded knolls giving cover from view and a good field of fire to front and flanks.

It is essential that such pivots should be capable of all-round defence, and that each should be able to sweep with

fire a large proportion of the ground lying between it and those on either side. If the pivots are strongly held and fortified, the number of troops necessary for the defence of the intervening ground need not be large, and the defence works themselves may be limited to ensuring that ground invisible to the defenders of the pivot groups is swept by fire. *A position, defended on these principles, lends itself to those local offensive movements which are so effective in keeping alive an offensive spirit in the defenders, in wearing down the attacker's powers, and in facilitating the delivery of a decisive counter-attack.*

The position, if extensive, should be divided into sections to each of which a name and number and a distinct unit or formation should be assigned. Definite portions of such formations should be detailed as garrisons to each of the localities referred to above, in the defence of which every article of field fortification should be brought into play. It is in the preparation of these pivots that field engineers should generally be employed.

Advanced Position.—With a view to misleading the attackers as to the situation and extent of the main position and thus creating favourable opportunities for the defenders to manœuvre against them, an *advanced position* may be occupied. Such a position should be distinct from the main defensive position, and may consist of groups of trenches and artificially strengthened tactical points. Special instructions as to the amount of resistance to be offered, and as to the direction in which they are to retire, must be given to the troops occupying this advanced position.

A clear distinction must be drawn between the occupation of an advanced position and of advanced posts. The latter are localities which are occupied in order to deny ground to the enemy, and not merely as a screen to the main position. If they can be effectively supported by fire from the main

position, they may be of value in breaking up an attack; but the fact that they form salients against which the enemy may be able to bring a heavy converging fire must be given due consideration when coming to a decision.

Commander of Group of Posts.—Within each section the commander may organize subsections describing them in any manner best calculated to assist the troops. Example: *No. II. (North-East) Section, C Subsection (Green Farm).*

The general duties of the commander of a group of posts in an entrenched zone are those laid down in Infantry Training, 1914, for an outpost commander. During the construction of the entrenchments he should study his surroundings so as to obtain information as to the strong and weak lines of fire, the points from which fire can best be controlled, and communication with other posts arranged. Where practicable, he should examine the position from the attacker's point of view.

He should prepare a sketch of his command on as large a scale as possible, showing the general arrangements of the works, obstacles, kitchens, latrines, etc., the ranges to various range-marks, and the points from which adjacent works can best be supported. This sketch, together with any other information, such as work still to be carried out, special arrangements by night, and points where the enemy has been observed, must be handed over on each transfer of command.

Selecting and Preparing Defensive Positions.—The following general rules should be borne in mind when examining a locality which it is desired to strengthen:

1. The *strong and weak points* of the position to be defended should be carefully studied, and the site for entrenchments chosen with due regard to tactical requirements and *economy in men.*

2. The enemy in attacking should be continually *exposed to the fire of the defenders*, more especially for the last 300

or 400 yards. To ensure this, the foreground may require improving.

3. The enemy should be *deceived as to the strength and dispositions* of the defending troops, and the character of their works.

4. The defenders should be *screened from the enemy's view*, and sheltered from his fire by natural or artificial cover, so arranged as to permit the maximum development of their own rifle-fire.

5. *The free movement of the attacking troops should be hampered* by obstacles to detain them under fire and to break their order of attack.

6. *The free movement of the defenders should be facilitated* by improving communications within their position and clearing the way for counter-attack.

The first step in the work of preparation is to improve the field of fire, both by clearing the foreground and by taking ranges to all prominent objects. These ranges may be supplemented by fixing range-marks, with which, as well as with the ranges taken, the troops should be made familiar. Range-cards should be prepared and supplied. Objects in or near the position, which might assist the enemy in ascertaining the range, should be removed or altered in appearance.

Cover.—The chief point to keep in view in providing cover is that *the fire from it should be effective*, but facilities for concealment, control, communication, and for the supply of ammunition, food, and water must also be considered.

Fire-Trenches.—The principal defences will as a rule consist of fire-trenches, which may be disposed in irregular lines or in groups with intervals, according to the character of the ground.

In tracing trenches which are to provide flanking fire, steps must be taken to protect them against enfilade fire, especially from artillery at long range.

To increase the volume of the defenders' fire, tiers of trenches may sometimes be employed; while in other parts of the position trenches may be arranged in échelon, which will make it difficult for the attackers' artillery to keep more than a small portion of the defenders under fire. There must, however, be no idea of using trenches, arranged in depth, as successive lines of defence. This must be clearly understood by the defenders of all trenches constituting the main zone of defence, which should be held to the last.

Flanks.—Careful arrangements are necessary to prevent the extreme flanks of an entrenched zone, which do not rest on an impassable obstacle, being quickly turned. Such flanks should be gradually refused in échelon until some suitable supporting pivot is reached. *They should not be turned back obliquely to the main front*, as this exposes them to enfilade fire, and does not seriously increase the circuit of a turning movement. The allotment of a mobile force to the flanks in addition to such defences is a question which the superior commander must decide on the spot.

Sites.—The ideal site for a trench is one from which the best fire effect can be obtained, in combination with complete concealment of the trench, and of the movements of supports and reserves in rear. Such positions being rarely found, the best compromise must be sought, bearing in mind that a good field of fire up to about 400 yards is of primary importance.

When the position includes commanding ground, the firing-line need not necessarily be on it. The advantage of high ground for a defensive position is often over-estimated. It is, however, desirable that the position should conceal and shelter the defenders' reserves and communications, while enabling the movements of the enemy to be observed.

It may sometimes be advisable to place the infantry fire-

trenches at or near the foot of a slope so as to obtain a grazing fire, while the artillery is posted on higher ground in rear. It must, however, be remembered that it will be difficult, if not impossible, to reinforce the defenders of such trenches, or to supply them with ammunition, water, food, etc., during daylight.

Length and Arrangement of Trenches (see also Section 6).—Every endeavour should be made to arrange the trenches so that the front of one is swept by the fire from those on either hand, for which purpose short trenches up to 40 yards or so in length are more easily adapted to the ground than those of greater length. *Provided the field of fire is good, a parapet cannot be too low, and in some cases no parapet at all need be provided.*

Trenches should not be sited in exposed positions, such as the tops of bare hills or of prominent salients, if this can be avoided, and all excavations should be made to assimilate the background. Salients and advanced posts which are held in order to deny ground to the enemy, and not merely as a screen to the main position, are a weakness if they are exposed to artillery fire which cannot be answered, and if they cannot be supported by effective infantry fire. As a general rule it is better to leave such positions unoccupied, and for the ground between them and the main position to be defended by fire from the main position. On the other hand, advanced posts which can be supported effectively by fire from the main position are often of value in breaking up an attack.

Generally speaking, it is easier to arrange covered communication with high-sited trenches, but these often entail a certain amount of dead ground in front of the position. It is sometimes possible to avoid this by arranging for the fire from one trench to sweep the ground in front of another, and *vice versa*, but too much reliance should not be placed on this method, as it is difficult for the garrison of a trench

which is being heavily attacked to fire in any other direction than that of its immediate opponents. Trenches placed at the foot of slopes are more easily concealed and admit of a more grazing fire than high-sited trenches. They are therefore usually preferable, even though the supply of reinforcements, ammunition, food, and water to their garrison may involve difficulties. Trenches which can bring fire to bear at close range on to the ground over which the attack must pass, *and which are themselves concealed from the attackers in the early stages*, are most valuable in surprising the enemy at critical periods.

Obstacles.—The general position and extent of obstacles will be decided by the commander of each section, who in fixing their position and nature must bear in mind the need for facilities for local counter-attack and for the eventual assumption of the offensive.

Supports.—Deep trenches in covered positions in rear of the fire-trenches may be usefully provided for that part of the firing-line which it is decided to hold in support, or for the whole garrison of the advanced trenches till it is required. When garrisons are thus held back, a few men must be posted in the trenches to keep a lookout, and communicating trenches will usually be a necessary addition, in order to ensure covered connection with the fire-trenches. If it is not possible to provide cover and communications for the supports, the latter may be merged in the firing-line from the outset, but in this case every effort must be made to obtain overhead shelter from the shrapnel fire in the firing-line.

Local Reserves.—Local reserves should be posted under natural cover if available, and their rapid movement in any direction in which they may be required must be facilitated. If it is necessary to make artificial cover for reserves, it must be made clear that this is not a secondary position, but that the cover is merely prepared to shelter the troops until they are required.

Instruction in Field Fortification.—The actual work of altering the ground and making the simplest forms of entrenchment to fortify it can be explained easily, and can be executed by anyone with sufficient strength to use a pick and shovel or other simple tools for a few hours if no other considerations—including the fire of the enemy—have to be taken into account. But to acquire the power to make the least necessary alteration of ground for field-works at the right moment, in the right place, with the right object in view, and as quickly as possible, necessitates careful and thorough military training and tactical knowledge.

The importance of this statement can be realized by the light of a single example. For instance, it is essential that the line of field-works constructed for resistance should be placed so that it is a matter of urgency for the enemy to try and force a passage through it at a certain time and place, or at least to detach a force to watch it. *If the enemy can afford to ignore the line of resistance formed by the field-works, and still proceeds with his plans unchecked, it is obvious that they have been sited at the wrong place or time, and are valueless in relation to their object.*

Method of Training.—Neither the technical nor military knowledge necessary for efficient instruction in the art of field-works can be given by theoretical training indoors. Practical instruction can only be carried out in open country under the greatest possible variety of circumstances, of ground, and of assumed action on the part of an enterprising enemy. The field engineer, of course, receives a special technical training for his difficult and important duties in his own branch of the service. The training of the infantry soldier in field fortification, which is now an essential part of his duties, will be based upon his general military training in character, physique, discipline, and knowledge, and more especially upon his musketry and field training, which teach him the use of ground and cover in attack and defence, for outpost duties, both by day and night.

There is no final ideal to aim at for fitting men to deal with all possible situations which may arise in war; but they may be trained to combine a thorough knowledge of the art of field fortification with a knowledge of the weapons used by their possible enemies, as well as of the tactics in attack and defence which these enemies will employ, and which often differ from those which the British Army adopt under similar circumstances. Many good opportunities for imparting this knowledge will present themselves during the training of troops in various exercises in the field. Much valuable instruction may also be imparted by lectures illustrated by lantern-slides and pictures explaining the principles of field fortification and the use of the spade by riflemen in modern warfare.

Miscellaneous Information.—In the Appendix will be found a glossary of definitions and the technical terms used in this book, together with information regarding tools and materials, the organization of working parties, and the correct methods of carrying out their tasks. This information, which is illustrated by photographs and diagrams, is necessary alike for carrying out instruction in field-works and for constructing them in the field. *In order that field-works may be designed to the best advantage, the effect of rifle and gun fire on different materials at various ranges should be fully realized.* Information on this subject will be found in the Appendix, p. 195.

II.—Use of Villages, Buildings, and Woods in Defence.

Use of Villages in Defence.*—If it is decided to occupy a village, either in the main zone of a defensive position or as

* See also *Military Engineering* and the *Drill and Field Training Manual* of this series.

a supporting point in rear, every effort should be made to organize an obstinate defence. Such places, strongly held, not only assist in breaking up the attack, but may be of great assistance in driving out the enemy, should he succeed in penetrating the position. It will as a rule be advisable to regard a village as a section of the position, and in no case should the main highway through a village form a boundary between adjacent sections of defence. The superior commander will decide whether a village, situated in a position, is to be occupied or not.

Suitability for Defence.—The suitability of a village for defence depends on—

1. The nature of its surroundings.
2. The extent and shape of the village itself.
3. Its liability to destruction by artillery fire.

As regards 2, villages lying end-on to the enemy can often be made strong against flank attack, and may therefore be useful on the flank of a position.

Garrison.—For the defence of a village, a definite garrison should be detailed under the command of a selected officer. The latter will be responsible for selecting the main and any interior lines of defence, for dividing the village into subsections, for allotting to each a proportion of the garrison, for arranging for a central hospital for wounded men, and for notifying the position of his headquarters. A general reserve should be retained in the hands of the commander to deliver counter-attacks against any of the enemy's troops who may succeed in entering the village, and to man the keep if one is prepared.

Subordinate Commanders. — Each subordinate commander should consider the preparations for the defence of his subsection in the following order :

1. Improvement of the field of fire.
2. Provision of cover and preparation of buildings for defence, much of which may be done concurrently with 1.

3. Provision and improvement of communications.
4. Provision of obstacles and barricades.
5. Arrangements for extinguishing fires.
6. Ammunition-supply.
7. Food and water.
8. Removal of sick and wounded.
9. Retrenchment and contraction if hard pressed.

Firing-Line.—The firing-line should usually be entrenched well in front of any buildings, to prevent casualties from shells which burst against their walls, and arranged to bring a powerful volume of fire on the best lines of attack.

Guns.—Guns and machine guns should not as a rule be located amongst buildings, as there is considerable risk of their being discovered in such a position, in which case they are likely to become the object of concentrated hostile fire. Concealed positions in rear and to a flank should preferably be selected from which to flank a village and bring a cross-fire on the enemy's probable lines of approach, and from which they can be more easily moved in accordance with the progress of the battle.

Bridges.—If, as is often the case, important bridges are located within the village, definite instructions as to their value to the commander should be obtained before defence preparations are commenced.

Use of Buildings in Defence.*—Buildings, *when not exposed to artillery fire*, may be of great defensive value. They should not be held when actually under artillery fire, as they afford a conspicuous mark, and the danger from flying débris caused by shells is considerable; but, if time and labour are available, they should be prepared for defence, and occupied when the artillery fire ceases.

Special Preparations.—The following special preparations require attention:

* See also *Military Engineering* and the *Drill and Field Training* Manual of this series.

1. Bullet-proof barricades to doors and windows. The means of exit, not necessarily on the ground-floor, must be dealt with in a special way. It is easier to make loopholes in the barricades rather than to attempt to loophole the walls.

2. Arrangements for ventilation, for the storage of ammunition, provisions, and water, for a hospital, and for latrines.

3. Arrangements for extinguishing fires.

4. Destruction of any outlying buildings which are not to be occupied, bearing in mind the importance of leaving no adjacent cover where an enemy might collect for assault.

Interior Defence. — If the building is large and strongly built, and it is intended to make an obstinate defence, arrangements must be made for interior defence by loopholing partition walls and upper floors made bullet-proof and strengthened, if necessary, to sustain the extra weight. Material with which to improvise additional cover or movable barricades to cover the retreat from one part of the building to another, or from one building to another, must also be provided.

Use of Woods in Defence.*—Woods vary so much in character that it is impossible to give instructions for their use in defence which shall be suitable in all cases. The two attributes common to most woods are the *obstruction* they offer to the passage of troops, whether in defence or attack, and the *concealment* they provide. As to the obstacle, it is the defender's business to arrange that it shall cause the least inconvenience to his own, and the greatest inconvenience to the enemy's troops. The concealment afforded should be so utilized as to be almost entirely in favour of the defence.

Special precautions are necessary for the defence of woods

* See also *Military Engineering* and the *Drill and Field Training* Manual of this series.

which run forward from a position towards the enemy, since they make co-operation between the artillery and infantry of the defence almost impossible and afford the enemy a covered line of approach. In the case of large woods, the difficulty of controlling troops engaged in them, the liability of those troops to lose their way, and the rapid consumption of reserves, make the improvement of their communications one of the first considerations.

If time is limited it will generally be best to devote it to improving the communications rather than to multiplying obstacles. For infantry several parallel tracks cleared of undergrowth are of more value and take less time to make than one broad road. The front edge of a wood often has a boundary capable of being quickly made into a good fire position, but usually offers a good mark for artillery fire; for this reason it may be desirable to place the firing-line some 200 yards in advance, this being about the maximum distance short of the wood at which shrapnel should burst, in order to be effective.

If by clearing the undergrowth a good field of fire can be obtained between the tree trunks, the firing-line may sometimes be placed with advantage 25 to 50 yards within the wood. In order to economize troops, those portions of the front from which effective fire can be developed should alone be occupied by the firing-line, the remainder being entangled. Where roads, rides, or clearings exist in a wood, the rear edge may be organized as a second line of defence. Such positions have often proved sufficient to stop the advance of troops who have succeeded in penetrating the front. On the other hand, entrenchments and clearances on a large scale in the interior of a wood will seldom repay the time and labour necessary for their construction.

If defences in rear of a wood are more convenient than in front, the best arrangement will be to straighten and entangle the flanks and rear edge and take up an enfilading

position some distance behind. The rear edge may be cut so as to leave well-defined salients into which the attackers may crowd and so provide a good target. In making clearances much can be done by judicious thinning, and large trees should not be felled. Communications throughout the wood should be blocked in this case.

Camps, Outposts, Lines of Communication, and Redoubts.—The following pages deal mainly with the working details of field fortification as they concern the rifleman. Instruction in the tactical employment of field-works, including redoubts, for the defence of camps, outposts, and lines of communication, detached posts, etc., will be found at further length in the *Manual of Field Engineering* and other official manuals.

CHAPTER II

HASTY FIRE-COVER

Protection when Firing.

Section 1.—General Information.

1. Before his training in field fortification is commenced the soldier will be taught how to use ground and cover of various kinds so as to obtain the best field of fire, and to use his rifle most effectively while he is afforded the greatest degree of protection from the enemy's fire. He has now to be taught how both these aims may be attained through the least alteration of ground by the use of his entrenching tool. The practical instruction of the rifleman in spadework should commence with consideration of means by which ground features may be hastily altered to provide protection from the effects of an enemy's fire *during the delivery of fire by the rifleman.*

2. **Use of Miscellaneous Materials.**—It will be assumed that he has chosen the best fire-point available in the absence of time or facilities for making any alteration of the ground itself or of the foreground. Under these circumstances hasty fire-cover, in the absence of sand-bags, may be improvised by the use of *any available movable objects* which can be arranged by hand so as to form bullet-proof * cover for men firing in the prone position. Examples of such miscellaneous materials are large stones, bricks, hard coal, steel plates, rails, or joists, bundles of fish plates,

* See Appendix II.

railway chairs, bags, sacks or boxes filled with small stones, nails, bolts, chain, earth, or sand. Each of these objects, or parcel of objects, should be as heavy as can be moved conveniently, and should not be less than 30 to 40 pounds weight. Otherwise the cover may be scattered by the impact of bullets and become a source of danger rather than protection to the rifleman.

3. This cover must be arranged so that it will protect as much of the body of the firer as possible from fire from his front or either flank. If small in size, cover should be

Fig. 1.—HASTY FIRE-COVER.

arranged so that the firer can shoot round the side of it rather than over the top, as the former method gives better protection. If more than one bullet-proof object is available, the firer may be able to arrange them so that he can shoot through the space left between two of them (Fig. 1). In doing this, however, he must be careful not to restrict his field of vision or the effective use of his weapon.

4. If materials are available for making further cover, the rifleman must consider from which side he may need protection from the fire of the enemy other than that from which he has already protected himself. If uncertain as

to the direction from which such fire may come, it will usually be best for him to arrange extra cover so as to protect his body from fire from the highest ground visible within rifle range.*

Section 2.—Improvement of Ground with Existing Cover.

1. The soldier must next be instructed in the alteration of the ground as he finds it, with or without the additional use of materials such as those described in Sec. 1 The ground must, of course, be suitable for a fire-position, and its shape or features should also, when possible, favour rapid alteration with little labour. Digging tools, such as an entrenching implement, or shovel and pickaxe, will usually be necessary for carrying out rapid alteration of ground.

2. Common Features of Ground.—The following common features of ground, which favour rapid alteration, are general in European countries.

(i) **Raised Features.**—A small bank, with or without a hedge, fence, etc., on it; a large bank or embankment; an embanked road or railway; a dam or dyke; the parapet of an old-fashioned fort; the rampart of a Roman camp; a mine 'tailing heap' or dump; a wall, window, or door in a wall; a gate, fencing, or railing.

(ii) **Sunken Features.**—A shallow, dry ditch; the edge of a deep or wet ditch, ravine or watercourse, or of a road, railway, quarry, pit, or other artificial cutting; the bank of a river, canal, or reservoir.

3. General Directions.—The following general directions

* The problem of the best disposition of materials for such cover is dealt with later, in connection with the construction of head-cover and traverses.

must be followed in the early stages of the work of improving a selected fire-position by alteration of ground:

(i) **Concealment** — Men must avoid exposing themselves to the enemy's view as much as possible, and try to avoid any alteration of the ground which will make their position more conspicuous to the enemy.

(ii) **Raised Cover.**—They must try to put bullet-proof material in front of their heads and chests as quickly as possible. *Soft earth without stones must be as thick as the length of the rifle to stop bullets at close quarters.** If there are stones, men must judge how much less thickness will do. When cover consists *entirely of stones*, 6 inches of thickness is safe, but some soft earth must be put as padding over the stones to prevent splinters injuring their faces.

(iii) **Parapets.**—When raising a parapet of loose earth in front of them, the part nearest to the men, called the *interior slope*, must be made to stand up as steeply as possible to give good protection. This is done by building up a revetment or supporting wall of lumps of harder stuff, such as the turf off the ground surface, solid clods, stones, pieces of board or sticks, bags of earth, etc., which are sufficiently firm to stand the pressure of the loose earth without giving way. If some pieces of board or stout sticks are available, they would be employed to better advantage, as shown in Fig. 26, than if used as a revetment.

(iv) **Sunken Cover.** — When digging, men must excavate earth so that they sink into the ground until they can fire standing upright. A hole measuring 1½ feet across at the bottom and about 2½ feet across at the top is about the

* As a general rule a thickness of raised cover or parapets of loose earth equal to the total length of the service rifle, from butt to muzzle (44½ inches), is bullet-proof in all soil except wet clay (see table Appendix II., p. 195).

smallest they should make. The depth of the hole will depend upon how far down they can sink without unduly limiting their field of fire and upon how high in front of them they can pile displaced earth for bullet-proof cover without making it conspicuous to the enemy.

(v) The depth excavated added to the height to which material is built up in front should together total about five-sixths of the height of the man digging. Men must not attempt to make exact measurements in feet or inches, but must roughly calculate measurements, using the rifle and their own height as standards. A man 5 feet 5 inches in height will usually find a total cover of 4 feet 6 inches convenient on average ground. A man 6 feet high can probably fire over 5 feet of cover with comfort.

(vi) **General Arrangements.**—If time is available after existing cover has been altered satisfactorily for firing standing, men must ascertain that the parapet is concealed or is not conspicuous to the enemy. They should also improvise a steady and comfortable rest for the arms and elbows when firing, a handy ledge or recess at the right side on which to lay out clips of cartridges for reloading, and a step nicked out of the front of the pit so that they can spring up and out to the front at a moment's notice.

(vii) **Communication and Cover.**—If further time is available, men may make arrangements for communication or improve cover according to orders or to their own judgment. For communication a furrow may be dug from the back of the pit as far as that of the next man on the right, along which a man can crawl if necessary without exposing himself to the enemy. This furrow will, if required, be deepened and widened until men can walk upright along it.

(viii) If artillery fire is likely to be heavy, cover may be improved by leaving a step 1½ feet wide at the bottom of

the pit and digging deeper still at the back, say, another 2 feet deep, until a man can stand at least 6½ feet below cover, or sit on the step with his back against the side of the pit next the enemy, as in Fig. 2. Both these improvements will probably be necessary if men are to remain for long at a firing-point. In this case both cover and communication will probably be improved until they attain the strength of deliberately executed entrenchments, as described later.

(ix) **Drainage.**—In the event of heavy rain arrangements should be made to *prevent water running into the pits off higher ground.* A slight " catchwater " furrow will usually be sufficient to divert the water. The amount of rain which will actually fall into the pit would seldom amount to more than a fraction of an inch. This should be drawn down to one corner and allowed to soak away, or may be baled out.

4. Notes on Illustrations.—Figs. 2 to 7 illustrate examples of the simplest treatment of existing cover, such as banks, ditches, walls, etc., according to the directions given in para. 3 above.

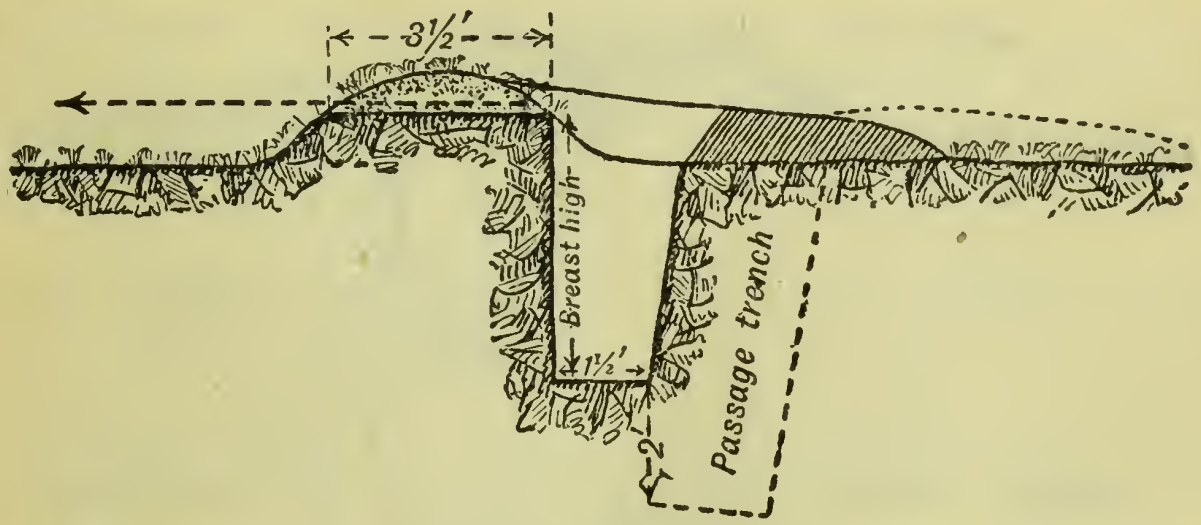


Fig. 2.—NARROW BANK, WITH OR WITHOUT HEDGE, CUT DOWN TO BULLET-PROOF LEVEL.

Fig. 2 shows a low bank which may or may not have a hedge, etc., upon it, the top of which, not being bullet-proof, is accordingly cut down at each firing-point, *but not indiscriminately or throughout*, until the requisite thickness for cover is obtained. The earth removed from bank and rifle-pit is shown disposed at the sides and back of the rifleman, care being taken that no signs of the change are visible from the front. The shape of the cut in the bank, as viewed from above in plan, will depend upon the extent of foreground to be swept by fire, and should follow the rules given later for forming loopholes.

If there is a strong hedge on the bank, the stems which are growing in the part chosen as a firing-point should not be cut down, but it must be arranged to fire between them. This should also be done with heavy roots as far as possible, unless saws or other cutting tools are available. The edge of the spade on the head of the entrenching implement makes a fair chopper if sharpened on a grindstone. If there is an existing ditch on the defenders' side of the bank, it will reduce the amount of excavation necessary; but steps must be taken to put it out of use as a drain for water by blocking and diverting it at an upper end and by intercepting fresh surface water by means of the back parapet or parados.

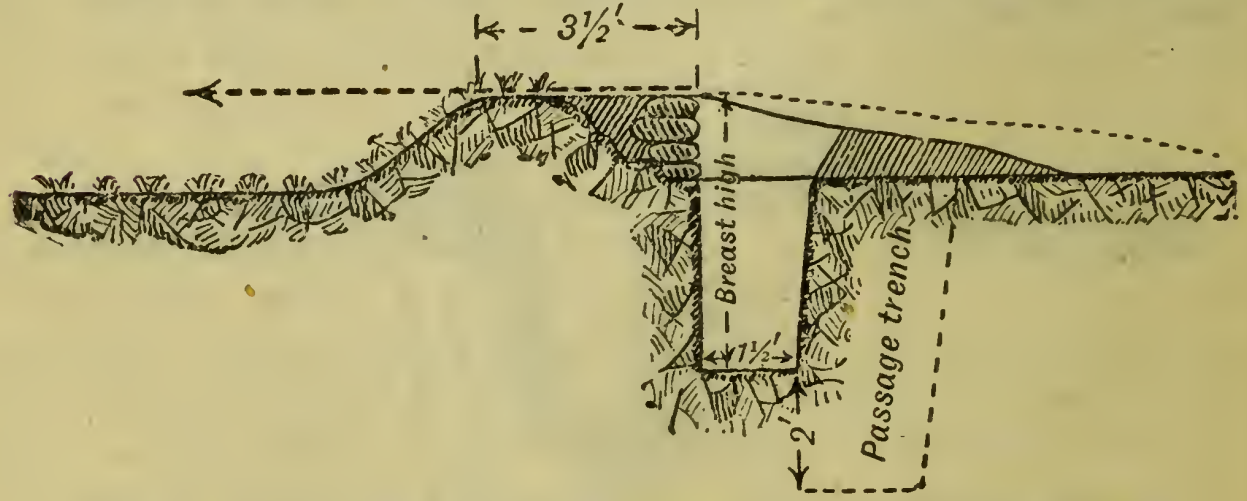


Fig. 3.—Narrow Bank widened to Bullet-Proof Thickness at Top.

Fig. 3 also shows an example of a bank which is not bullet-proof at the top, but if the top is cut down, as in Fig. 2, the rifleman

may not be able to see properly to shoot over the foreground. In this case the defenders' side must be raised to the full height of the bank *at bullet-proof thickness*, and the new earth retained in position by blocks of hard earth, layers of turf, sand-bags, etc., and by cutting small ledges on the slope of the bank, to keep the earth from sliding down.

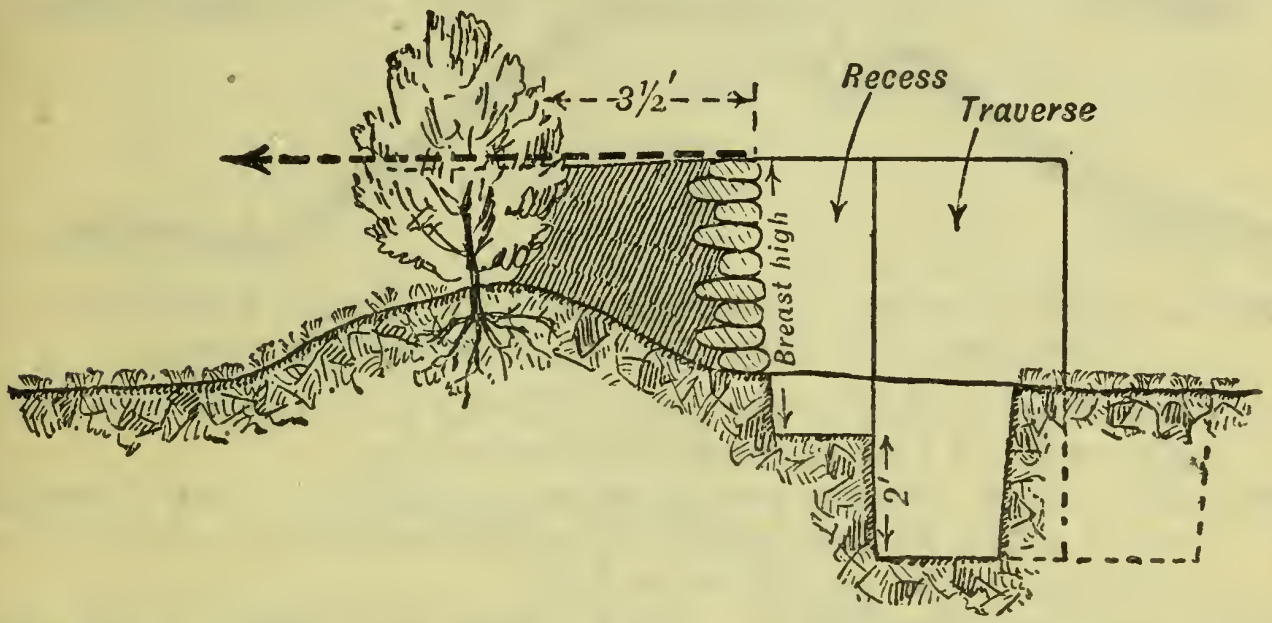


Fig. 4.—Strong Hedge used to screen and support a Parapet of Some Command.

Fig. 4 illustrates an example where the whole bank is too low to afford the required command or view over the foreground, and advantage is taken of the presence of a strong hedge to utilize it as a combined screen and revetment. Some skill is required to prevent the parapet showing through on the enemy's side; and the fact that the top of the hedge is some distance in front of the rifleman makes it difficult to arrange for a clear view without undertaking a suspicious amount of thinning of the hedge. This treatment may also be considered typical of any case where an existing screen of unsuspicious appearance is also strong enough to act as a revetment for materials piled on the defenders' side, or which can be made strong enough by wiring or anchoring it back towards the defender, such as a wooden paling, sheet-iron fence, or other non-bullet-proof wall.

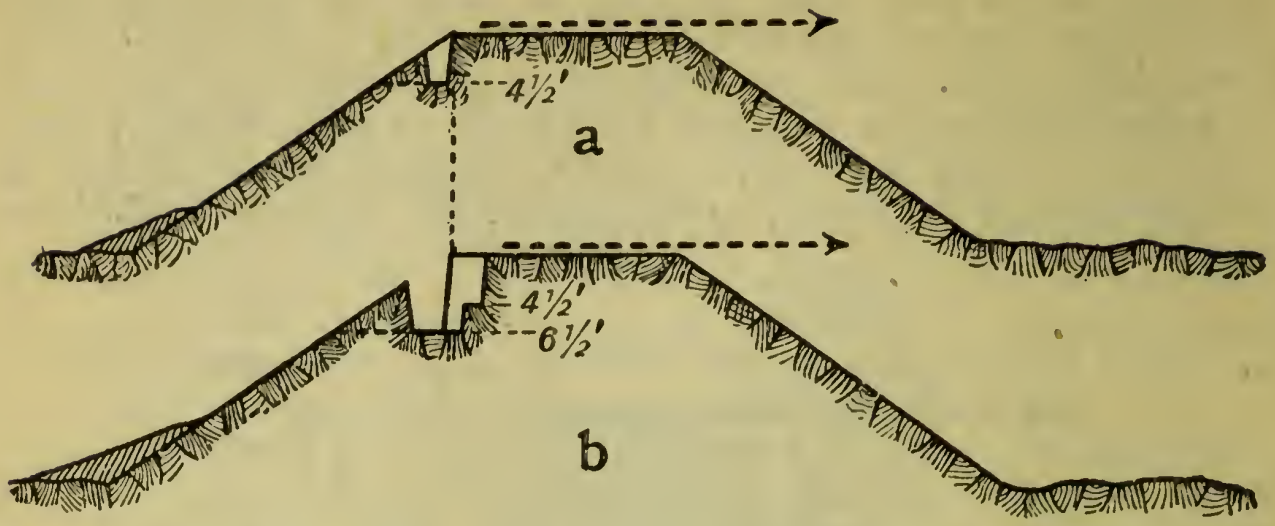


Fig. 5.—EMBANKMENT OCCUPIED AT THE REAR EDGE, OR A CUTTING OCCUPIED AT THE FORWARD EDGE.

(*a*) *First Stage.*—Single rifle-pits, for firing standing, at required intervals, on first occupation of rear edge.

(*b*) *Later Stage.*—Firing-points recessed forward, and passage trench made 6½ feet below top of embankment, with openings to the rear at intervals.

NOTE.—If the embankment carries a road or railway, it may be necessary to raise a parapet of sufficient height to clear the crown of the road or the tops of the rails, unless the firing recesses reach to the nearest rail or to the crown of the road.

Figs. 5 and **6** give typical examples of the improvement of a large bank, embankment, or cutting, for use by riflemen. A conspicuous embankment would not as a rule be selected as a good firing-point for riflemen if exposed to artillery fire, since (i) it would easily be ranged, (ii) the artillery could support their attacking infantry fire till they were right up to the foot of the embankment, and (iii) considerable mutual co-operation on the part of the defenders is necessary to sweep the forward slope of the embankment with rifle-fire, *as it is not practicable for the riflemen to entrench themselves close enough to the forward edge to see and fire down the steep slope and at the same time have good bullet-proof cover.*

If the rifleman entrenches at the forward edge, he should work at least 5 feet back from the front of the embankment, so that, after providing an elbow recess at his firing-point, the cover will still be bullet-proof at the top. A deep cutting may be of use to the rifleman as a good place for cover in which to collect for a strong forward rush; also as a convenient place for constructing shelters for supports to a firing-line entrenched in front of the cutting, or, if well swept by fire, as a good place for constructing and hiding an obstacle or entanglement.

Whether the rifleman entrenches himself behind or in front of the cutting depends entirely upon which situation will enable him to get results from his fire which will best assist in the destruction of the enemy. The question is usually decided by the nature of the foreground and by the facilities for assisting the men on the right and left of

(*continued on next page*)

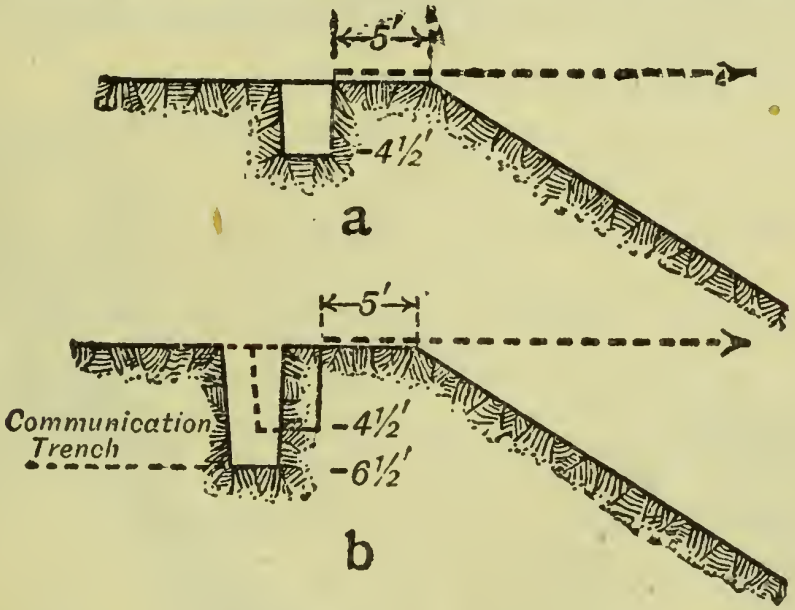


Fig. 6.—EMBANKMENT OCCUPIED AT THE FORWARD EDGE, OR A CUTTING OCCUPIED AT THE REAR EDGE.

(*a*) *First Stage.*—Single rifle-pits, for firing standing, at required intervals, not closer than 5 feet from forward edge.

(*b*) *Later Stage.*—Passage trench, made 6½ feet deep from pit to pit, and to the rear, leaving the front half of original pits as firing recesses. Additional firing recesses cut forward from the passage trench as required. Communication trenches to the rear as required.

the firing-point selected. It would only be by some chance coincidence that either the back or front *edge* of a cutting afforded the best firing-point for the purposes in view.

The above principles apply also to the use of other deep holes or depressions, such as quarries, ravines, pits, the bank of a river, canal, or reservoir. It should be remembered that all such features are usually marked on the map, and that it would be natural for the enemy to suspect their use as cover for troops, and to concentrate their artillery fire accordingly.

Fig. 7 illustrates a typical example of a bank with a deep ditch on the side nearer the enemy. The field of fire being sufficiently good from the edge of the ditch, and the bank being obstructed and rendered conspicuous by a thick hedge, it would be better to occupy the forward edge of the ditch. The treatment of the firing-points in this example would also apply to the edge of any steep bank, such as at a quarry, river, ravine, etc.

Fig. 7.—A Deep Ditch and Heavily Rooted Hedge, prepared for firing from Enemy's Side of Ditch.

Section 3.—Walls.

1. Effect of Rifle-Fire on Walls.—Masonry walls, of brickwork, stone, or concrete, occur in such profusion in all civilized countries that their use and limitations as fire-cover for riflemen must be understood clearly. A brick wall, one brick thick (9 inches), is not bullet-proof unless built with cement mortar. If built with lime mortar, bullets penetrate at the joints, which in such a wall run through from side to side. The hardness of the mortar can be tested with a knife or some sharp instrument before taking cover behind a wall.

2. A brick wall *more than one brick thick*, any stone wall with no joints running straight through the wall, and a cement-concrete wall more than 3 inches thick, are all bullet-proof. A wall built of sun-dried clay lumps will not be proof against rifle-fire as a rule, unless at least 40 inches thick, and such walls, which are common in many European country districts and amongst natives of tropical countries, should be carefully avoided as fire-cover.

3. Effect of Artillery Fire upon Walls.—Two walls several yards apart, as the front and back of a house, will usually suffice for temporary protection against *field-gun fire*. The first wall will burst the shell and the second intercept the splinters, but this protection will not remain effective for long under continued fire. *Howitzer high explosive shells* will throw down the partition walls and back wall of a house as well as the front wall; so that a "row of houses" cannot be considered good cover from such artillery fire. Behind two rows of houses the cover may be considered fairly good until the buildings take fire.

4. No wall can be used as fire-cover under effective artillery fire for obvious reasons, but it may often be most useful (*a*) when artillery fire has ceased, or (*b*) in situations where the enemy's artillery cannot locate the wall with

sufficient accuracy to fire at it. Examples of the latter occasions will frequently occur within large townships and suburbs. The enemy's artillery will find it difficult to get the range of the particular walls or buildings in question, or to spare a large amount of ammunition; and if the guns are brought up to point-blank range, the advantage should lie with the riflemen of the defence.

5. Firing from Walls.—As a general rule, where time is important, it will be quickest to arrange in the first instance to fire *over the top* of any wall up to 7 feet high, and over the window-sills in the walls of houses. In the case of walls more than breast high, something will be required to stand on, and each rifleman should improvise a platform from any portable objects available, such as tables, benches, chairs, boxes, tubs, tanks, chests of drawers, field gates, loose bricks or stones, paving slabs, old carts, wheelbarrows, rollers, step-ladders, etc., or a mound of earth thrown up for the purpose. When time and a supply of convenient materials, such as planks, poles, nails, cordage, or wire, are available, regular firing platforms may be constructed. These should be at least 2½ feet wide to allow men to pass, and a handrail, about 3 feet above the platform, may save a wounded man from a bad fall in addition. Some rough ladders or inclined plankways will be required at frequent intervals for access to the platform. Examples of walls prepared as firing-points are given in Figs. 8 to 15.

6. Loopholes in Walls.—In the case of high brick walls of a thickness up to two bricks thick (18 inches) loopholes may be cut, if pickaxes, crowbars, or mason's chisels are available. The usual height at which to cut such loopholes would be at the height convenient to a man standing on the ground by the wall—namely, for firing standing. To cut them at any other height would require either the provision of a platform or that

the man should work in a cramped position near the ground.

7. To cut a loophole in a brick wall one and a half bricks thick suitable for firing standing over level ground, at effective and close ranges, the following procedure will usually be convenient (see Fig. 13): Count eighteen courses of brickwork up from the ground, and scratch on the wall above this course a rectangle two brick-lengths (18 inches) long by three courses of brick (9 inches) high. Set to work with the pick or crowbar to shatter the brickwork within this rectangle, and remove the pieces by hand, gradually reducing the size of the hole by cutting away less brickwork at the sides and top, until at the front of the wall the hole only shows as about the size of the end of one brick ($4\frac{1}{2}$ inches wide by 3 inches high). Leave the bottom or sill of the loophole level at first.

8. Then try the loophole with the rifle, *sighted to the estimated ranges*, and aim in turn at all points of the foreground to be brought under fire. If it is found that the sights are not clear of brickwork at the longer ranges, do not increase the height of the small opening in front, but break away another course of brickwork from the sill of the loophole on the *inside*, try the rifle again, and continue shaping as necessary. Each loophole must be shaped, however roughly, until the required field of fire is obtained. Then select a brick-end from the débris and replace it loosely in the front of the loophole ready for removal by hand when required, and behind this arrange a ball of grass or rags, etc., until no daylight can be seen through the loophole. Such a loophole should not take an untrained man more than half an hour to prepare by the methods described.*

* Well-built masonry and concrete walls will seldom repay the time and labour necessary to cut loopholes through them by such rough methods, and assistance from the engineers will usually be required to deal with particular cases where loopholes are urgently required through such walls.

9. Dummy Loopholes and Notches.—If the foreground provides cover for the enemy at close ranges during an attack, dummy loopholes or marks can be made by breaking out a portion of the ends of bricks on the exposed side of the wall, sufficient to cast a shadow. This may help to dissipate the effects of aimed fire at close ranges by multiplying the number of targets offered to the enemy. Walls may be notched along the top, as described in the note to Fig. 10, p. 33.

10. Notes on Illustrations:

Fig. 8 shows a wall less than breast-high. It does not provide sufficient cover for firing standing, and is too high to allow of firing kneeling. Riflemen may sink a hole in the ground to stand in, the depth allowing them to fire conveniently over the top of the wall with sufficient protection. Later on these pits can be joined up to provide safer communication for men moving along behind the wall, and the back

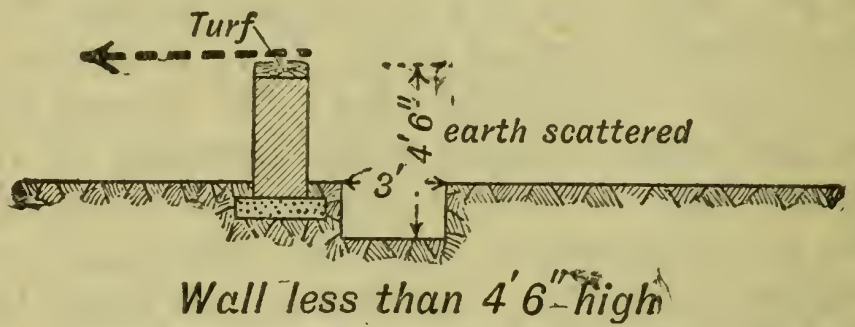


Fig. 8.—PREPARING LOW WALL AS FIRING-POINT.

of the trench can be deepened still further, if required, as in previous examples. The layer of turf on the top is to save the rifleman's face as far as possible from splinters of brickwork caused by bullets which strike the wall near the top, and to provide a better rest for the hand or rifle. Strips of carpet, fibre mats, empty sacks, etc., will answer the same purpose.

Fig. 9 shows a wall more than breast-high, which has been prepared for firing over the top by making a platform from planks resting upon tables, etc., chairs being used as steps.

Fig. 10 shows the same type of wall prepared with a firing-step of earth. In addition, better protection for the head has been provided by cutting notches out of the top of the wall similar in shape to the loopholes described above, but open at the top. It is difficult to conceal the fact that a wall has been prepared with notches at the top, though the actual construction of them is usually quicker than loopholing. About ten minutes' work will usually suffice to make a notch with a pickaxe. They can also be made with the pick end of the entrenching implement, which is not long enough to use for cutting loopholes. On walls capped at

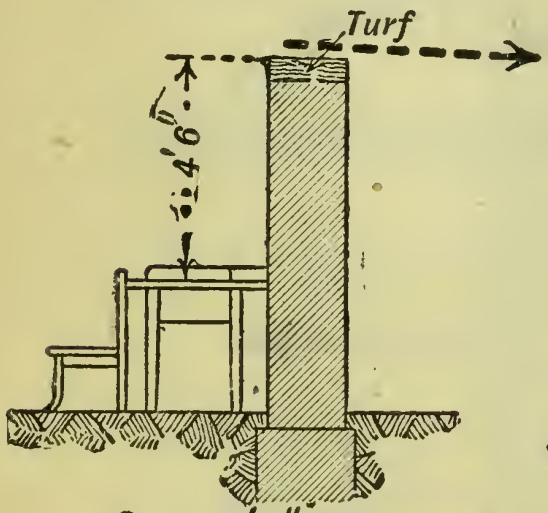


Fig. 9.—Firing Platform.

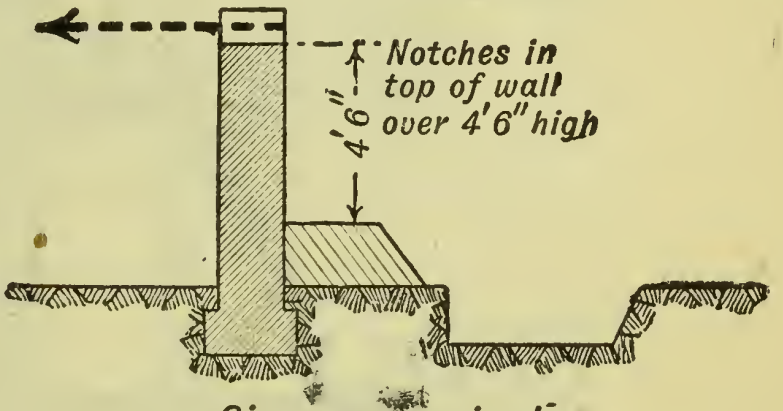


Fig. 10.—Firing Step and Notches.

the top with coping-stones, etc., rough notches can be made very quickly by removing one coping-stone at intervals, and replacing it on the wall to the left of the notch.

Fig. 11 shows two alternative methods of treating a fairly high wall. They would seldom both be used together for a double tier of fire. In the lower half the wall is shown loopholed breast-high, as already described. Above is shown a platform of planks supported by cross-pieces, called *put-logs*, about 4 or 5 feet long. With planks about 1½ inches thick, one put-log about 4 inches thick is required every 5 feet. One end of the put-log is let into the wall; the other end is supported by nailing, bolting, or lashing

it to the side of an upright pole, also about 4 inches thick, or more. The guard rail is secured in the same way on the inside of the pole near the top. The foot of the pole should be set in a post-hole about a foot deep, and the earth well rammed round it.

To prevent the accidental withdrawal of the put-logs, inclined struts may be provided to every second pole. At the points where access to the platform is desired, double struts, with their feet spread apart about 2 feet, and rough cross-bars fixed across them as rungs, will serve as ladders.

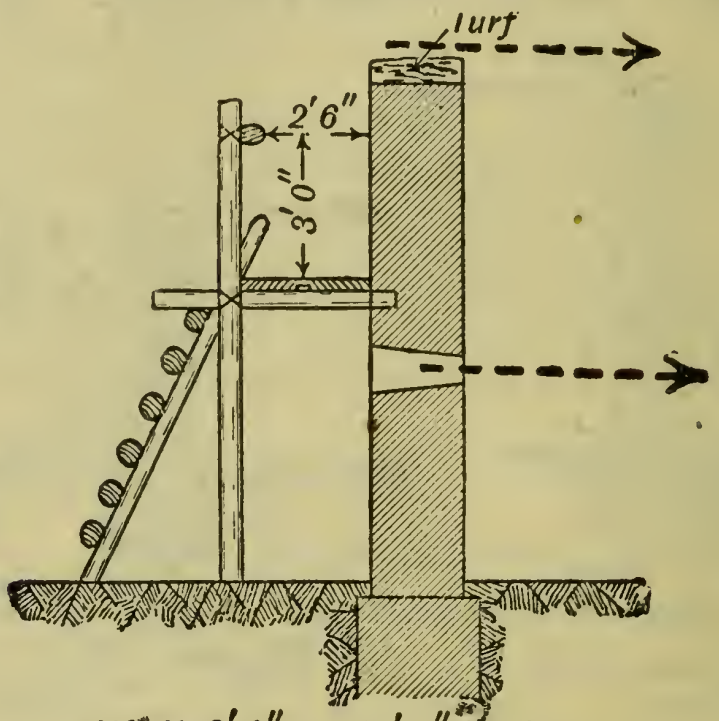


Fig. 11.—FIRING PLATFORM *OR* LOOPHOLES.

If spare planks are available, a few may be used as inclined footways, or *duck-ladders*, resting sideways against put-logs left long enough to project beyond the posts.

Fig. 12 illustrates the construction of a firing-platform behind a wall over 10 feet high. The point to note is that it is out of the reach of the men to cut put-log holes in the wall; therefore a second post is required to support the put-logs, and, as the latter cannot be wedged into the wall, the

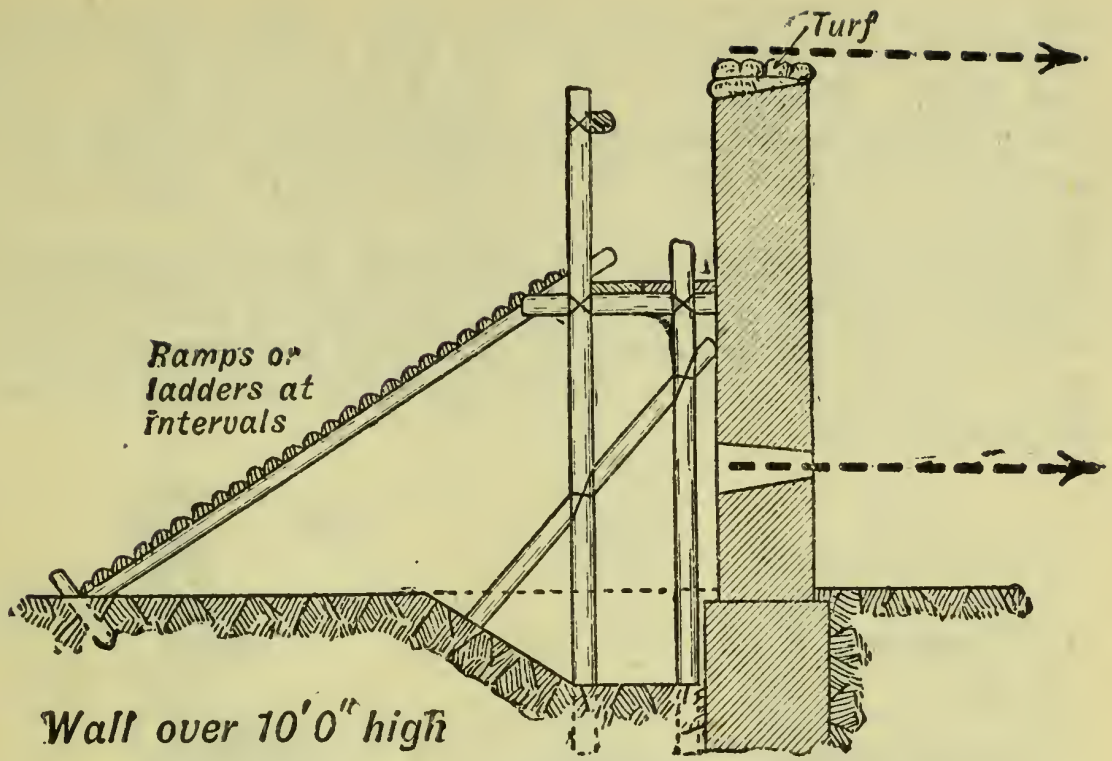


Fig. 12.—FIRING PLATFORM *OR* LOOPHOLES.

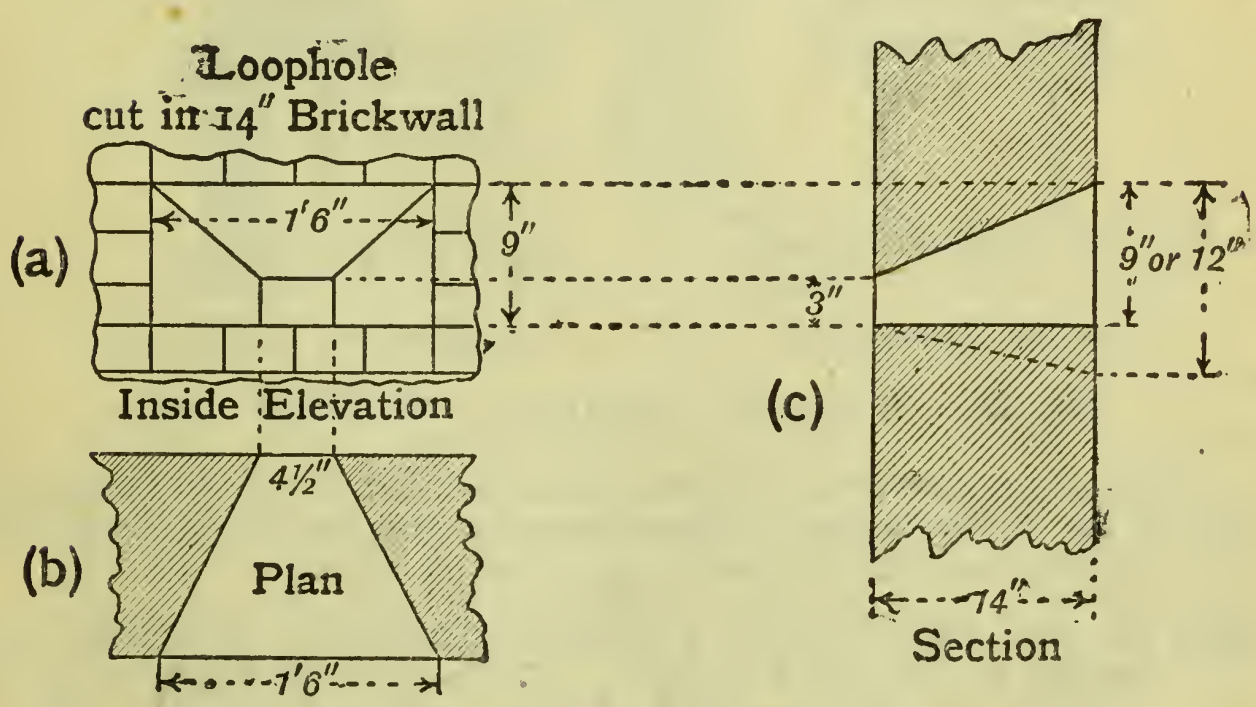


Fig. 13.—LOOPHOLES IN BRICK WALLS.

struts are essential to prevent men, when standing on the platform and pressing against the wall, from overturning the whole structure. The loophole is shown at a lower level than before, merely to suggest that it might be a convenience for the men to be able to walk along under the struts.

Fig. 13 shows the form and dimensions usually suitable for a loophole through a brick wall one and a half bricks thick. With rough implements it will not be possible to shape the brickwork neatly, and the form is only given as a general guide.

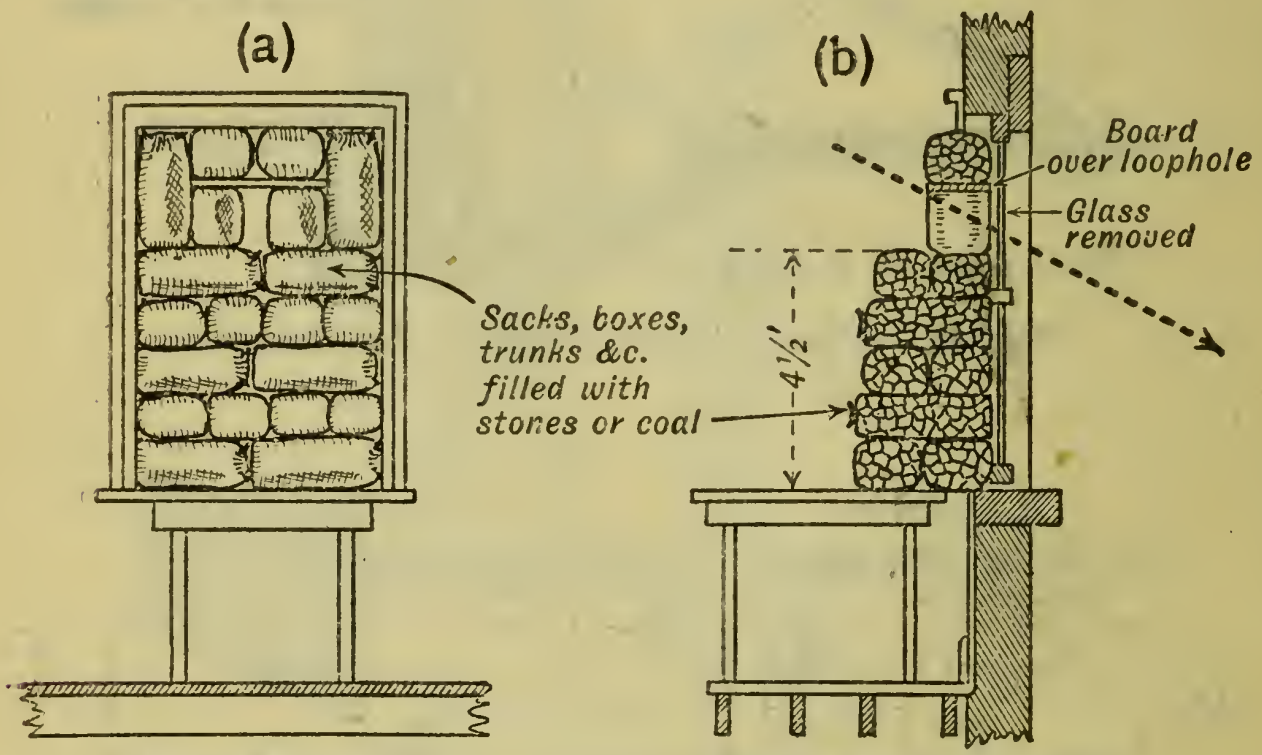


Fig. 14.—Window prepared for Rifle Fire.

Note.—If a narrower support than the table shown can be obtained for the sacks, etc., the rifleman can stand on the floor, and less material will be needed to provide cover.

Figs. 14 and **15** illustrate particular examples of firing from behind the walls of houses. The occasions when it is permissible to make use of buildings as fire-cover have already been discussed. *As a general rule it will be quicker to make*

use of the existing openings—namely, doors and windows—than to cut fresh loopholes. The treatment illustrated in these figures is applicable to either a door or a window.

In **Fig. 14** a window opening is shown blocked with a pile of sacks, boxes, trunks, a chest, cupboard filled with bullet-proof material, with a loophole for shooting through. The *height* of the loophole opening is determined by the amount of depression required in firing. A *width* of 2½ to 3 inches will usually be ample.

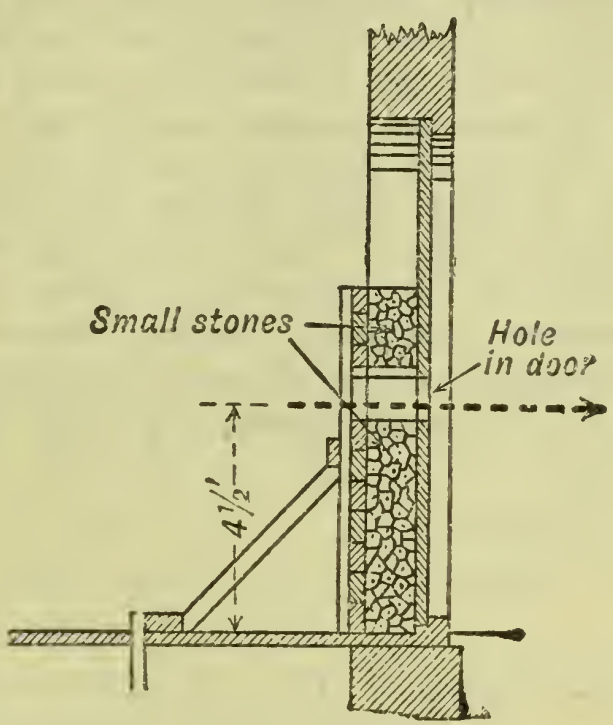


Fig. 15.—Door prepared for Rifle Fire (boarded up on Inside).

In **Fig. 15** a large gateway or door is shown boarded across on the inside, and the boarding shored up by struts which bear against a beam nailed to the floor, or if laid on the ground, kept in place by pickets driven behind it, and a bar above nailed to uprights, which in their turn support and strengthen the boarding. The hollow space between the boarding and the door, *which should not be less than 6 inches*, is filled with small stones, road metal, etc. Loopholes may be made of rough board similar in shape to

Fig. 13. Windows may be treated in the same manner, the glass being first removed in all cases.

Closing Door without Lock or Bolt.—To close a door firmly and quickly as a temporary measure in the absence of bolts, the blade of the entrenching implement, or the head of a hand-axe, used as wedges, and forced beneath the lower edge of the door near the side which opens, will resist considerable pressure on the door.

Caution.—It may be mentioned here that walls and buildings form a dangerous background for men close in front of them, on account of the ricochet from bullets which strike the wall and glance off; and *fire-cover should never be made in such situations without an ample back parapet or parados of soft material.* Walls or houses should never be relied on as a position for the main firing line in any situation exposed to artillery fire. Their principal value is for the control of streets in the heart of a town, and other situations where they cannot be located by the enemy's artillery (see *Drill and Field Training Manual* of this series: "Street Fighting," and "House to House Fighting").

CHAPTER III

ENTRENCHMENT IN THE PRESENCE OF THE ENEMY

Protection when Firing.

Section 4.—Improvement of Ground devoid of Existing Cover.

1. Ground devoid of natural or artificial cover will usually be selected for improvement by field fortification, because it affords a good fire-position owing to its situation. Such ground can be improved, after firing-points on it have been selected, by digging holes of the smallest possible dimensions which will provide protection, concealment, and safe communications with other bodies of troops, combined with the delivery of *effective fire by every rifle*. An example of such improvement is a rifle-pit or fire-trench. This form of spadework will be considered under two headings—namely:

(i) *Entrenchment in the presence of the enemy.*
(ii) *Deliberate entrenchment.*

2. Owing to the longer time required to execute entrenchments on chance ground in the open field, and the great difficulty of concealing the results sufficiently well to avoid a betrayal of their disposition, and so partially neutralizing their value, such work is only undertaken when other alterations of existing ground or adaptation of existing cover will not afford the increased fire effect which is desired.

3. At the same time, in country which is not heavily intersected with natural cover, such as holes, ditches, banks, walls, large boulders, etc., it will often be impossible otherwise to

grip new ground and establish a superiority of fire in a step-by-step attack against the tremendous resisting power of an enemy acting on the passive-defensive with modern weapons and the excavation of firing-points in the open becomes a necessity. There is a sharp distinction between the methods by which entrenchments are made in the presence of an enemy and those used when the work can be arranged and carried out without immediate danger of interruption.

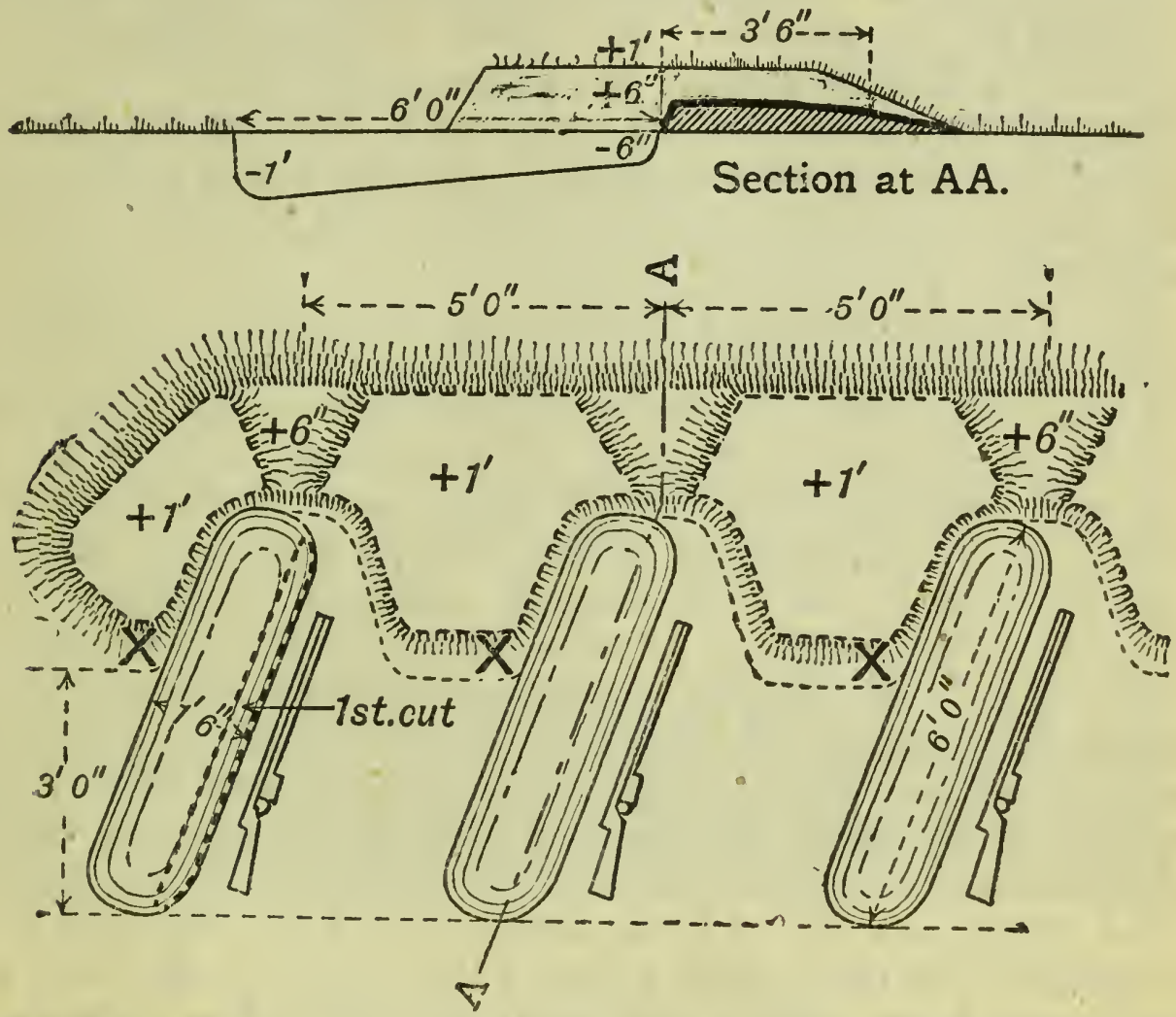
4. The essentials for successful entrenchment in the presence of the enemy by the individual soldier are a quick eye and a brave heart for the rapid choice and occupation of a suitable firing-point within a strictly limited area, and skill and speed in treating the firing-point, so that, while giving a good field of fire from the first moment it is occupied, it becomes safer and better with every stroke of the entrenching tool.

5. **Line of Sight.**—An important point for the rifleman to remember, when he begins to entrench himself at his chosen firing-point, is that there will be *a tendency for his eye to go down and his line of sight towards the target to go up as he sinks into the ground;* and he may find the targets he intended to fire at have dropped out of sight when he takes his rifle up again, *unless he took the precaution to keep the targets in view with his eye right down to the ground when deciding where to dig.*

6. **Order to Entrench.**—Before commencing to entrench, a definite order from an officer to do so is required by regulation, and *no entrenching should be done so long as there is any possibility of closing upon the enemy and using the bayonet.*

7. **Hasty Entrenching under Fire.**—The following instructions relate to digging hasty cover with the grubber under fire when lying prone on ordinary soil, which will usually have a hard crust on the surface. This form of cover is generally used during attack.

Directions for using Grubber.—(i) *First, the soldier should decide on the next firing-point on the ground ahead which he is going to occupy on the order to advance.* Then at his present firing-point he should lie back about 2 feet to the left rear



Figs. 16 and **17.**—Early stages of entrenchment by rifleman lying prone in the open, using grubber under fire. If under shrapnel fire all efforts should be directed towards making a deep hole, and not a shallow trench.

of the point from which he intends to fire, with his head at about the point marked **X** in Fig. 17.

(ii) He should see that the magazine of the rifle is charged and his cartridge pockets are fastened up, and lay down the rifle at full arm's length to the right, muzzle to

the front. He should next get the grubber out ready for use. He should then tear up and collect any vegetation within arm's reach, and heap it up loosely as a screen at full arm's length to the front.

(iii) Lying on the left side of the body, and using the pick or blade of the grubber, according to the hardness of the ground, he should quickly hack the earth loose in a furrow, about 1½ feet away on the right side, from as far back to the right rear to as far forward to the right front as he can reach, as shown by the dotted line in Fig. 17, left-hand pit.

(iv) Then holding the grubber by the handle close to its head, thumb pointing towards small end of handle, and, using the blade as a scoop or hoe, he should scrape the loose earth out of the furrow and *heap it up close in front of his left eye and shoulder*. He should hack loose another strip of earth along the *near* side of the original furrow, so that the grubber will strike into ground which is probably softer than the crust, and can thus be undercut and wrenched up from below. He should continue to scrape loose earth towards the parapet and hack off the crust until the furrow is about 1½ feet wide. Any lumps of earth available should be used to build up the near edge of the parapet as steeply as possible.

(v) Each new lot of loose earth should be disposed so as to thicken the parapet in a direct line between his head and the point from which the most accurate fire appears to come, or, if the enemy's fire seems to come from every direction, he may extend the parapet right-handed in a general horseshoe round the front of the trench, keeping the part of the parapet over which he intends to fire about 6 inches lower than the remainder, and of bullet-proof thickness if possible.

(vi) When the depth of the trench reaches about 6 inches at the front end and 12 inches at the back (Fig. 16), and

Figs. 18 AND **19.**—FIRE-COVER WITH THE ENTRENCHING IMPLEMENT (GRUBBER) IN HARD GROUND.

The upper figure shows the result of fifteen, and the lower figure of thirty, minutes' work on Figs. 16 and 17. Note the exposure of the legs to shrapnel fire.

To face p. 42.

Figs. 20. AND **21.**—FIRE-COVER WITH THE ENTRENCHING IMPLEMENT (GRUBBER) IN HARD GROUND.

Note.—The above figures show the same cover as Fig. 18 after forty-five minutes' and sixty minutes' work respectively. The pit is being developed on the lines of Fig. 25, A, B, C, D, to get the legs out of shrapnel fire.

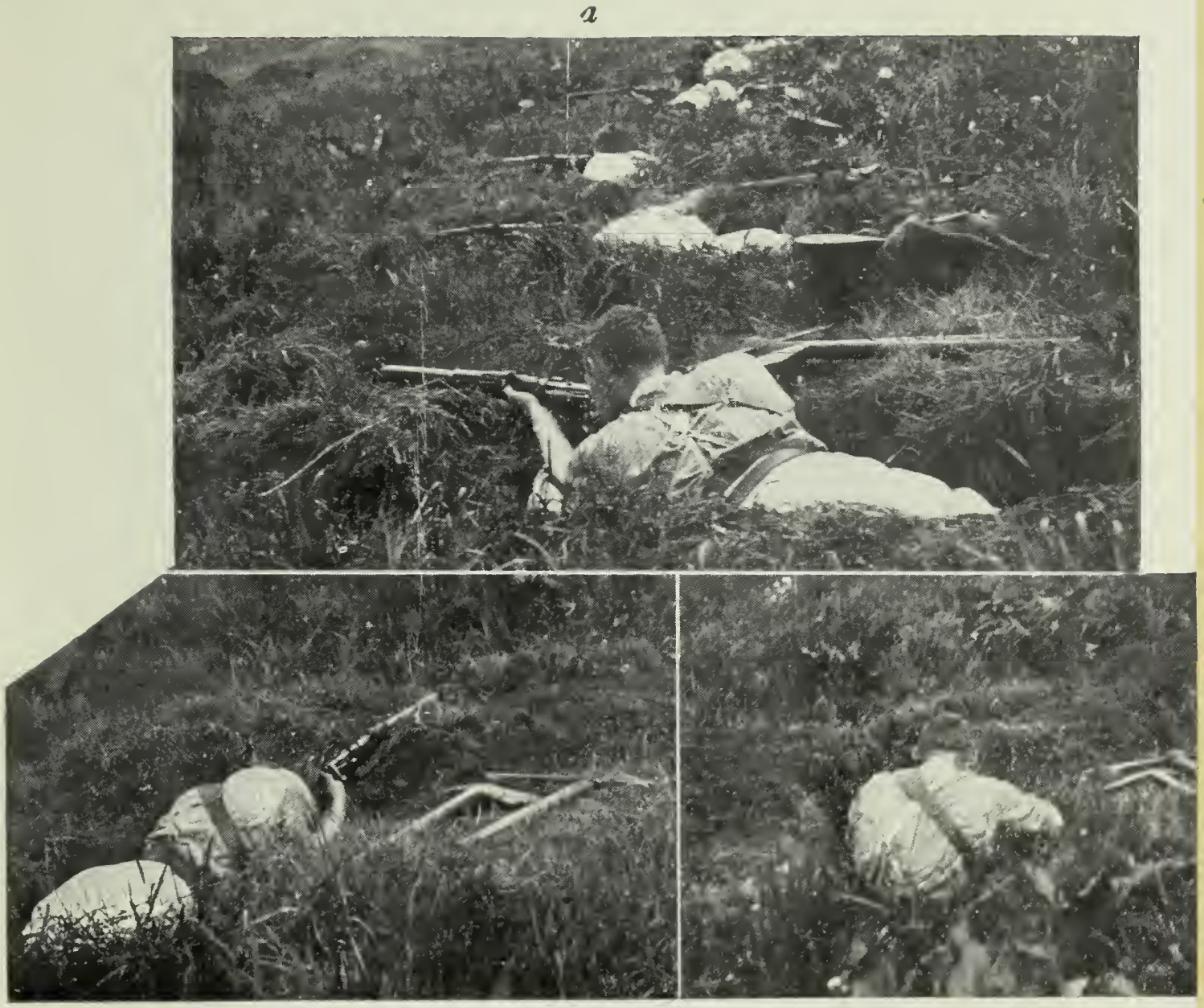
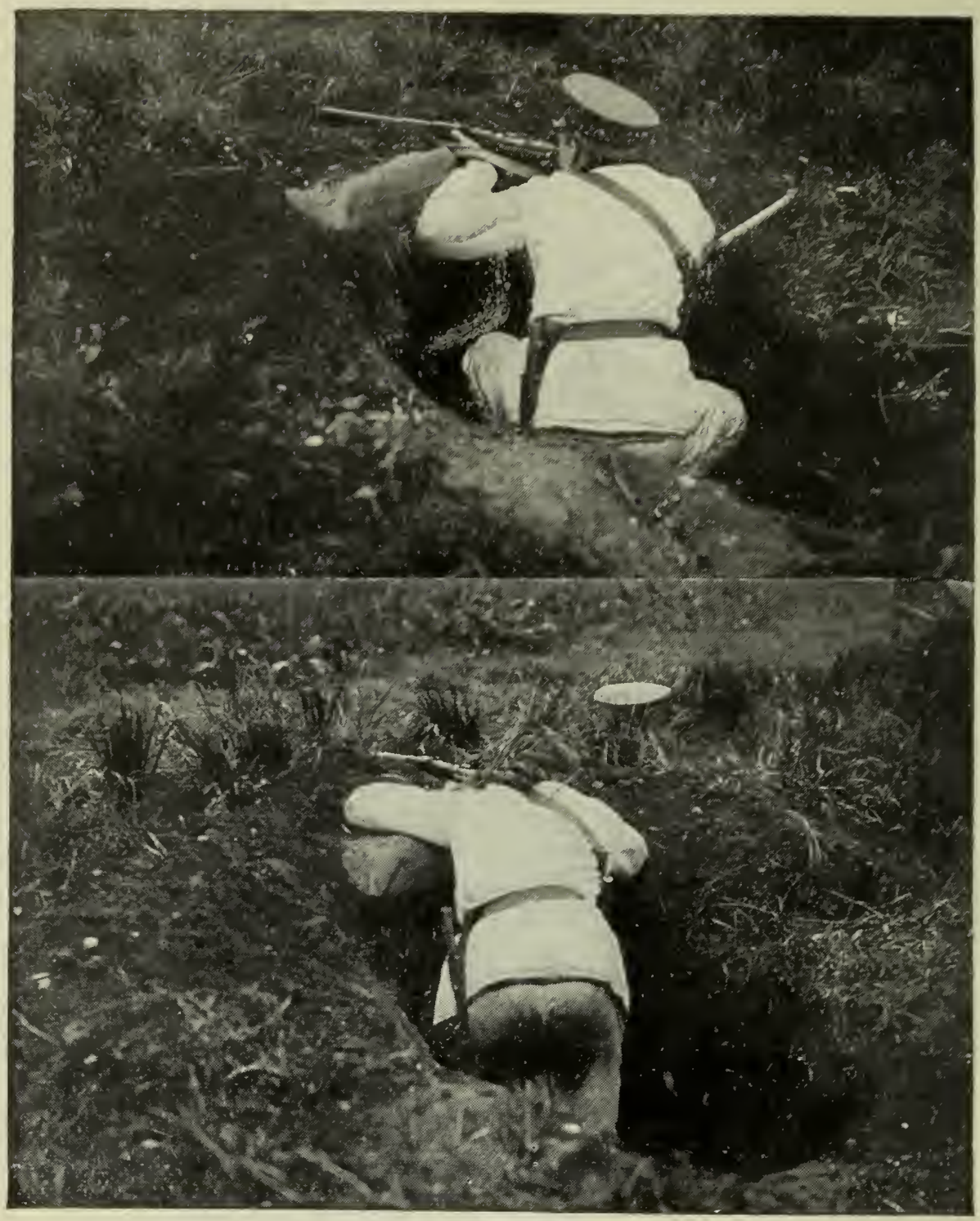


Fig. 22.—Fire-Cover with Pick and Shovel.

(*For explanation of this illustration see p.* 45.)

To face p. 42.



Figs. 23 AND **24.**—FIRE-COVER WITH GRUBBER IN EASY SOIL.

(*For explanation of these illustrations see pp.* 43 *and* 45.)

the parapet is 6 inches high and bullet-proof, some vegetation, if any is available, should be scattered over the parapet to conceal the earth thrown up. The soldier is then ready to join in the fire-fight, unless specially ordered to continue to improve his cover, as described later.

(vii) Each man must, of course, be ready to lay down his grubber and resume firing with his rifle at any stage of the work, or to spring up and advance at the word of command or signal; or, if previously ordered to move forward *whenever he can*, he must advance without hesitation the moment he gets a chance, or sees that his own force or its artillery are beating down the fire of the enemy to his front. *In advancing, men must take care not to leave their grubbers behind.*

(viii) **Factors of Time and Determination.**—The rifleman must not expect to obtain bullet-proof cover of any value at close range in less than thirty-five to forty-five minutes' work at hasty entrenching under fire. What can be done by a recruit with a grubber in nice easy soil is shown in Figs. 23 and 24. The mere fact, however, of obtaining concealment for the head and shoulders is of some moral value, even though the mound of earth forms for a time a better target to aim at than the body did alone. But once the rifleman has obtained good fire-cover, the value of his fire, the chances of his survival to use the bayonet, and the difficulties of driving him back by fear or panic, increase so greatly that his eventual success in attack is almost a certainty, *provided he does not cease to press forward to the attack with courage and determination, remembering that his spade is only a means to enable him to use his bayonet as quickly and effectively as possible.*

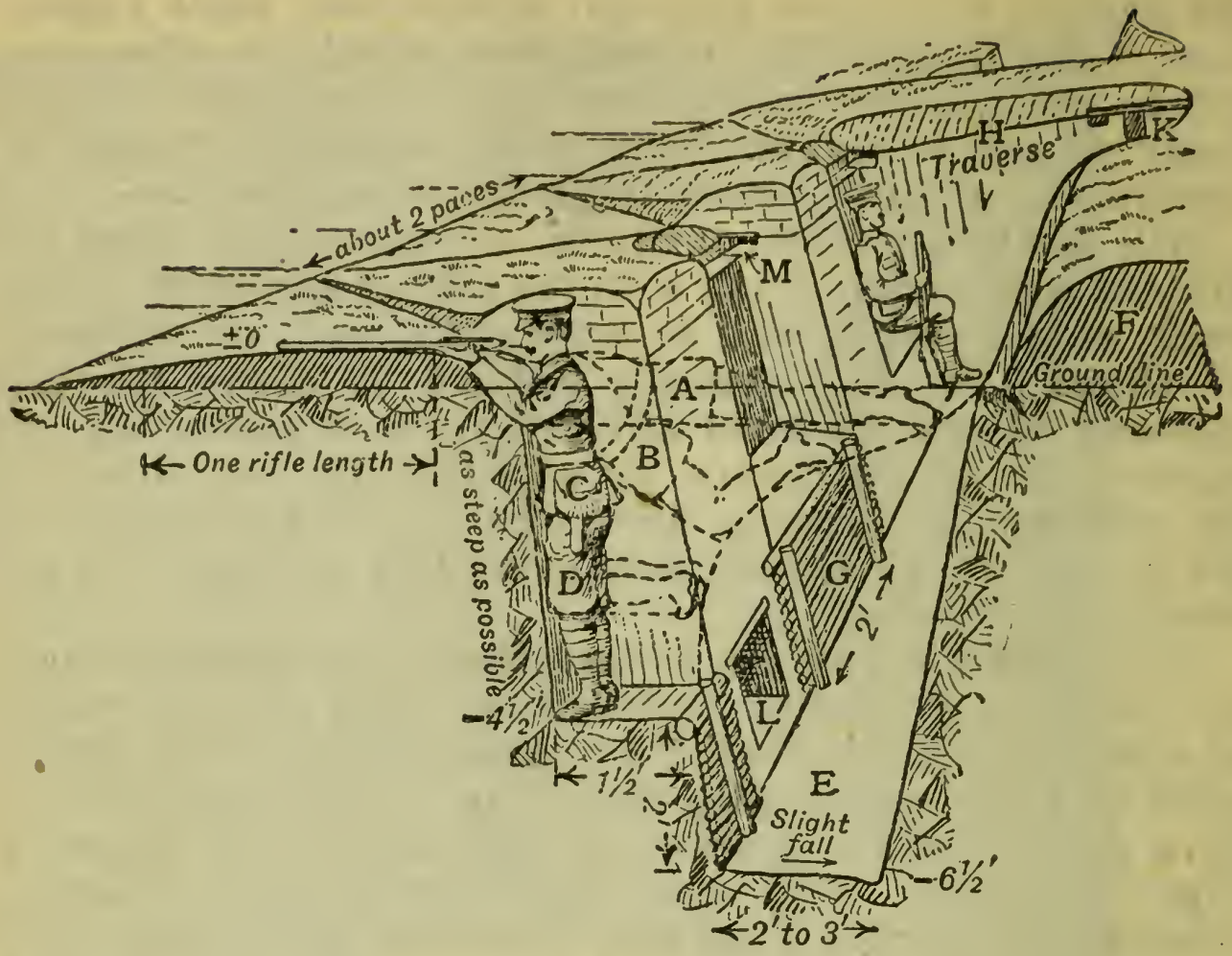


Fig. 25.—HASTY ENTRENCHMENT IN PRESENCE OF ENEMY. DEVELOPMENT OF FIRE-COVER COMMENCED WITH THE GRUBBER AS IN FIGS. 16 TO 21.

A, Rifleman lying in shallow trench. *B*, continues excavation towards cover kneeling. *C*, cover kneeling up. *D*, cover standing in a recess 1½ feet by 2 feet. *E*, passage trench; first a furrow for crawling, finally 6½ feet of cover. *F*, parados (back cover) and surplus earth. *G*, revetment of firing step. *H*, traverses of solid ground left at frequent intervals. *K*, passage round back of traverse, roofed into the parados. *L*, recesses for ammunition, water, and hand grenades. *M*, cartridge recesses, for use when firing. (*For further explanation of this illustration see p.* 46.)

7. Notes on Illustrations:

Fig. 18*.—Fire-cover made with a grubber in fifteen minutes in ground hard, but not stony, at the first attempt by a recruit aged 18 years. Trench about 6 inches deep; parapet on left of rifle only about 6 inches high by 2½ feet thick.

Fig. 19.—Same fire-cover as Fig. 18 after thirty minutes' work. Trench about 12 inches deep; parapet about 6 inches high by 3½ feet thick. Rifleman firing at ground-level round right side of parapet.

Fig. 22.—The men at *b* and *c* have been arranged to illustrate the meaning and value of enfilade fire. It will be seen that they appear to sweep the line of men at *a* from end to end, and that only one man in this line could reply to their fire by turning round to do so. This illustration also shows examples of fire-cover made by recruits using a pick and shovel. Line of men marked *a* and rifleman *b* have been at work fifteen minutes, and the rifleman at *c* thirty minutes. In fifteen minutes the amount of cover obtained with pick and shovel is slightly greater than with grubber (Fig. 18), but in thirty minutes it is appreciably greater. Compare man at *c* (Fig. 22) with Fig. 19. The pick and shovel, however, cannot be used above-ground *under accurate fire* like the grubber.

Fig. 23.—Thirty minutes' work. Parapet is 9 inches high by 4 feet thick, and quite bullet-proof. Pit is 2½ feet deep; total, 3 feet 3 inches of cover. The rifleman is provided with one sand-bag also, which he uses as "revetment" close to his chest. He preferred to shoot in the squatting position, but would be slightly better protected if kneeling up on both knees closer to the parapet.

Fig. 24.—Same cover as Fig. 23 after sixty minutes' work. Parapet 12 inches high, and pit 3½ feet deep; total, 4½ feet of cover. Rifleman can fire standing up. Parapet extends well round to his right and left, and is well screened with tufts of growing grass, etc., to harmonize with surroundings. He has also secured one tuft on his left shoulder to screen his face from view when firing, and left his cap on grubber as a target to deflect enemy's aim from himself at close quarters.

* The ground shown in Figs. 18 to 22 inclusive is hard, with a surface of turf over sunbaked clay, very hard to break up.

Fig. 25.—Compared with previous illustrations, as regards progress, the stages shown by outlines of rifleman may be taken as roughly equivalent to the following figures: *A* as Fig. 19; *B* as Fig. 20; *C* as Fig. 21 or 23; and *D* as Fig. 24. The rifleman has not quite reached stage *c* in Fig. 21 in sixty minutes in hard ground, but has done so in Fig. 23 in thirty minutes in soft ground, though both men were digging with all their strength in competition against each other.

8. Improving Hasty Entrenchments.—The hasty entrenchments made under fire, as described in para. 7 of this section, must be improved if men are ordered to hold their ground. Improvements may include protection against the possibility of *enfilade rifle-fire* from the right or left flanks (Figs. 22 and 37), and overhead cover from *artillery fire* (Fig. 26 and Section 9, Chap. IV.). Protection from enfilade fire may be obtained by heaping earth to bullet-proof thickness to the right or left of the cover, in the same manner as in front. The first step in improving hasty entrenchments is to continue excavating so as to pivot the body downwards, round the elbows as a hinge, until first the knees and finally the feet are brought as nearly vertically below the elbows as the stiffness of the soil will allow the front of the pit to stand. Fig. 25 illustrates these developments by the outlines of the rifleman marked *A*, *B*, *C*, and *D*, in successive stages.

9. It is not essential to follow the stages shown in Fig. 25 rigidly in executing the work of improving hasty entrenchments. In soft ground a short-cut to stage *C* may often be attempted successfully under fire; but the rifleman *must never be caught by the order to open fire with his pit in such a shape that he can neither kneel nor raise himself, when prone, to shoot without exposing himself.*

10. Converting Pits into Fire-Trench.—When full cover for shooting in the standing position has been reached, the pits may gradually be converted into the fire-trench shown in Fig. 17 (dotted outlines), and Fig. 25, completed except for shelters (Chap. V.).

(i) **Passage Trench.**—First of all communication with the adjacent firing-points must be improved, and the portions of ground right and left of the firer must be excavated until it is possible to crawl right along the line of men in comparative safety from rifle-fire. The full development of this passage trench may be considered complete when its floor has been sunk at least 6½ feet below the level at which the rifle is fired—that is to say, about 2 feet below the firing step on which the rifleman stands—and when it is widened to some 2 or 3 feet at the bottom, according to the steepness at which the back of the excavation will stand. Two feet width at the bottom will be sufficient in soft soil, with a gentle back slope, while 3 feet will be required in stiff soil, which will stand up nearly vertical at the back, the object being to provide a gangway wide enough for men to carry a stretcher 2½ feet wide without either interfering with men who are on the firing step, or scraping their hands against the back slope of the excavation.

(ii) **Firing Step.**—It will usually be desirable to strengthen the back edge of the firing step to prevent it from crumbling away with repeated stepping up and down; this can be done by securing a small log, a piece of stout branch, or a plank on edge, or other suitable material level with the step. A thin or sharp material, such as sheet iron, etc., is both weak to step upon and uncomfortable to sit upon, and should be avoided at the edge of the firing step, though such materials may be suitable for revetments elsewhere.

(iii) **Further Improvements.**—If the trench is to be occupied for some time longer, there are many further improvements which can be made, some of which are illustrated in Fig. 25; but as such work would fall under deliberate entrenchment, details will be given later.

(iv) **Simple Overhead Cover.**—There is one important improvement, however, which, though belonging properly to the subject of cover for riflemen when not engaged in

firing (Chapter V.), may be described now. In the attack, or in very hasty entrenchment in the presence of the enemy, little can be done at first to provide overhead cover from plunging or artillery fire. The simplest and quickest form of construction to attempt under such circumstances, provided materials are available, is for each man, or pair of men working together, to carry material

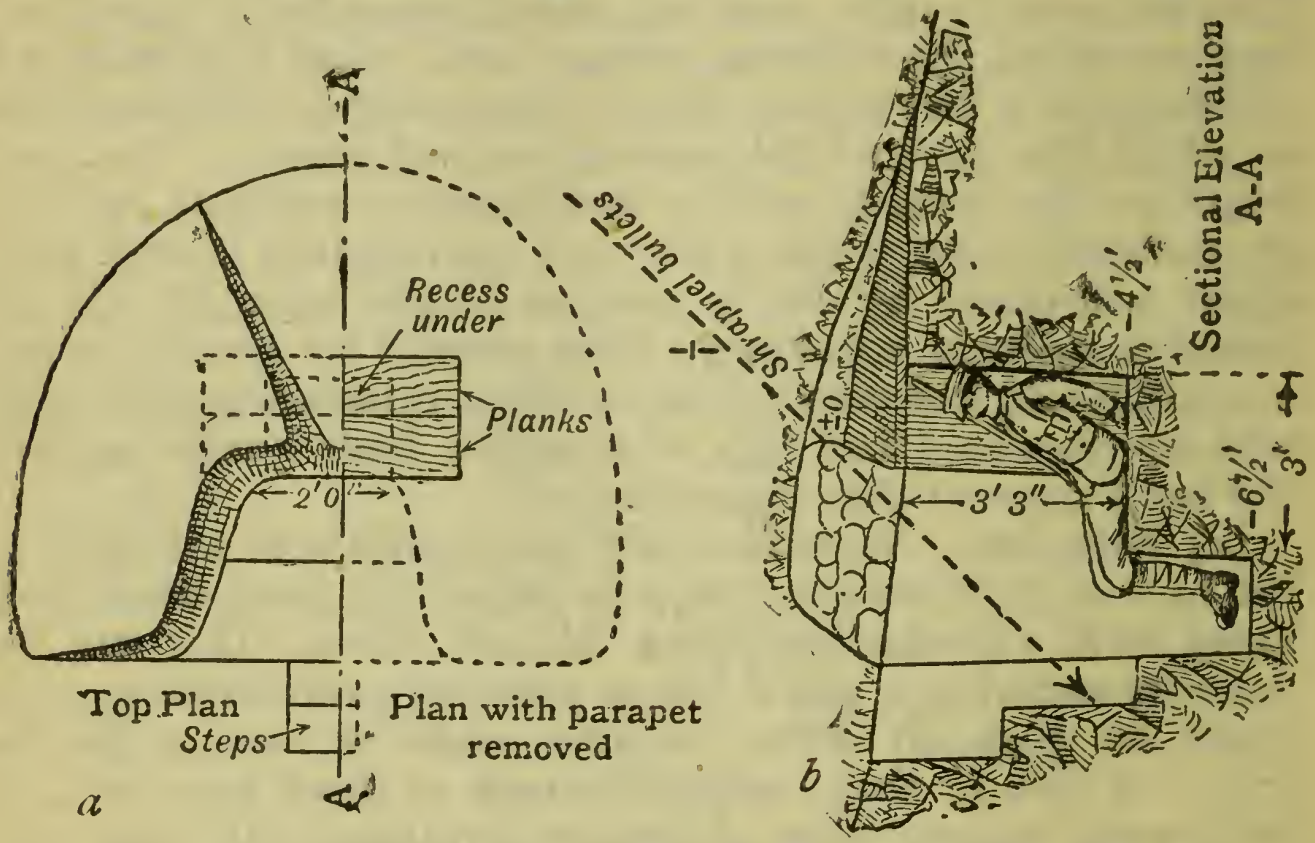


Fig. 26.—Parapet Shelter Recess for One Man.

to their firing-point, such as a piece or two of strong plank from 3 to 4 feet long by 1½ to 3 inches thick, or a door, shutter, or fittings, from a building. They should lay the material down on the surface of the ground, as shown in Fig. 26 (*a*) before commencing to dig.

(v) The principle of laying the roof of a shelter *on the ground* before commencing excavation is recommended in all cases where the timber, etc., available is strong enough to bridge the finished excavation *in one span* without intermediate supports—as the latter cannot, of course, be

placed in position until the excavation at the exact sites is completed, as the roof would either be temporarily overloaded or its covering with earth unnecessarily delayed.

(vi) The rifleman will then proceed to entrench himself in the usual manner, heaping up his parapet above and beyond the planks, etc., in accordance with his requirements for protection against direct fire. As soon as his excavation has reached the full depth to enable him to fire standing up, he can proceed to burrow or mine underneath the planks until he has made himself a little cave in which he can sit, with his back to the earth, in comparative safety from the heaviest shrapnel fire (Fig. 26, *b*). A width of 1½ feet is the minimum for a parapet shelter of this kind for one man, though 2 feet is more convenient, and in their construction on a larger scale the latter allowance of sitting space per man should be provided.

(vii) **Measurements.**—The minimum height for a man to sit upright under such a shelter may be taken as 3 feet 3 inches, and its convenience is much improved if a hole can be provided for the man to place his feet in the ordinary sitting position, after leaving 18 inches for the firing step.

11. Elbow Rest.—Formerly a ledge or shelf about 1½ feet wide by 9 inches deep was left all along the top of the interior slope of a parapet. This was intended to serve as a convenient rest for the elbow and as a shelf for cartridges. The result in action was to reduce the effective height of the parapet against shrapnel fire from 4½ to 3¾ feet. Recent experience has shown that this top 9 inches of cover close to the shoulder is of the utmost value to the riflemen, and should be carefully preserved. The Russians have now taught their riflemen to fire resting their rifle on the parapet, *with the left hand on the butt*, in order to press close to the parapet with the left shoulder well protected. Small recesses for cartridges are essential, and can be arranged as shown in Figs. 29 or 43. Without such recesses loose ammunition falls, and is trodden underfoot and wasted.

CHAPTER IV.

DELIBERATE ENTRENCHMENT

Protection when Firing.

Section 5.—General Remarks.

1. Object of Deliberate Entrenchment.—Deliberate entrenchment is usually employed when riflemen are not entrenching in the presence of the enemy. The procedure is somewhat different, and the execution of the work is usually a matter of convenience and economy in applying the available labour and tools in accordance with what may be called the tactical urgency of the various steps to be taken at each firing-point or group of firing-points. As soon as these steps have been decided upon, *those of them which would tend to improve the fire efficiency of units as a whole* must be put in hand before those which would only improve the firing of individuals or small parties. This is a question which requires great skill and experience on the part of leaders to decide correctly in any particular case.

2. Tactical Considerations.—In one part of the field it may be clear that *mobility and freedom for manœuvre* will probably be most favourable for the defence in firing on attacking troops, especially if the number of the defenders is small. In this case the first step would be to improve means of *communication* affording cover from the enemy's view between selected firing-points. If natural cover is available for this purpose, it should be improved hastily without unnecessary elaboration. Plenty of alternative firing-points should be selected, and the best approaches to them should be made known to all concerned.

3. In another part of the field it may be most advantageous to the defence to *clear the foreground of cover* which would afford concealment or protection to the enemy, and so increase the effect of the defenders' fire. In this case careful attention must be paid to leaving the enemy certain possible avenues or lines of advance, which he may be induced to take owing to their natural or other advantages. All these lines or avenues of approach must be commanded completely by the defenders' fire. Again, in another part of the field the best chance of successful resistance may depend mainly upon holding a position with small bodies of riflemen disposed at various firing-points, while the bulk of the defending force is kept under cover, ready to move and strike as required.

4. The most careful attention must be paid, in the instance last quoted, to arrangements for protecting the concealed mobile force from the effects of the enemy's fire until the time comes for it to act. It may be necessary to construct both shelters and covered approaches for communication with this object, so that troops may be moved to desired positions without suffering losses from the enemy's fire. It must be remembered, in carrying out this work, that the whole object of entrenchments is to improve the efficiency of the riflemen for fighting over ground *which he will have to occupy with or without their protection.*

5. *Entrenchments, therefore, will fail in their object if they do not protect riflemen against losses, and if they fail to increase their efficiency in striking power.* Besides being sufficient for their purpose, entrenchments, as already stated, must be made *where they are required*, and leaders must avoid the mistake of confusing, and perhaps spoiling, their commander's plans by entrenching at points which are attractive as defensive positions, irrespective of their relation to the tactical situation or to the immediate object of their commander.

6. (i) These important points are emphasized here in order *to clear the mind of the rifleman of incorrect ideas to the effect that either the wholesale clearance of all removable features on the foreground, or the entrenchment of every-one in a safe firing pit or trench, is the first consideration under all circumstances when acting on the defensive.* It is especially necessary to guard against incorrect ideas concerning deliberate entrenchment, because, as already stated, this form of field fortification is more often associated with measures of defence or *resistance* than with other forms of fighting.

(ii) Having made it clear that *deliberate entrenchment is not necessarily confined to the careful preparation of firing-points by providing elaborate protection for the rifleman,* some of the more typical forms of excavation which are classed under this head may be considered.

7. Selection of Sites.—The selection of the best sites for firing-points before the fire-fight commences is a much more complicated, difficult matter than when entrenching in contact with the enemy. The selection of sites in the main zone of resistance under various conditions is touched upon in Chapter I. and in Official Training Manuals. The broad principles laid down must be studied carefully and applied with judgment. *Instruction on this point can only be given by an experienced officer on the actual ground.*

Section 6.—Fire-Trenches.

1. A chain of firing-points for single riflemen which is provided with a continuous passage trench throughout its length is usually known as a *fire-trench;* and when deliberate entrenchment is possible, it is often permissible and convenient to excavate a complete length of fire-trench in one operation. If the work is liable to interruption by the enemy, the completion of the excavation

and concealment of the *most important points for delivering fire from it* must be completed before the remainder of the trench. The arrangement of the work is also affected by the labour employed to carry it out, and a different sequence is sometimes followed when working with untrained men or civilians, who may be employed to construct field works in war, from that followed when entrenchments are made by trained soldiers. *It is both an advantage and a standing rule, that, if done by military labour, riflemen should themselves construct the entrenchments they are to hold.*

2. **Length of Trench.**—(i) No fixed rules can be laid down as to the length of any one fire-trench in yards. The length in every case depends upon the number of riflemen who will occupy it, and other points which will be mentioned presently. Musketry fire from entrenchments is directed and controlled beyond short range by fire unit leaders in the same manner as upon other occasions.* Except, therefore, in the case of an entrenched sentry group on outpost duty, which may consist of three or four men, riflemen will not usually be entrenched in smaller bodies than about ten men. About one yard per rifle is the normal *minimum* allowance under ordinary circumstances, when it is necessary to crowd the rifles together.

(ii) **Other Considerations.**—The actual length of fire-trenches depends upon the amount of frontage taken up by *traverses* constructed for protection against enfilade fire, by *alternative firing-points*, by *passage trenches* cut past ground from which a clear field of fire cannot be obtained, and upon the nature of the ground itself. Occasionally it is important to provide a heavy volume of fire from a cramped or limited frontage, and riflemen must then be crowded shoulder to shoulder unless a machine gun is

* See *Musketry Regulations*, Part I., and the *Musketry Manual* of this series.

available. The fire from a machine gun is usually assessed as the equivalent of about 30 men firing rapidly. It is, however, easier to find a concealed position for a machine gun than for the number of riflemen required to produce an equal volume of fire.

(iii) **Overcrowding.**—The disadvantages of crowding men together when entrenched usually outweigh the advantages—by daylight, at any rate. The possible advantages are—(*a*) Less work in entrenchment; and (*b*) easier fire control. The possible disadvantages are—(*c*) greater vulnerability to shell fire and to converging or concentrated fire from both rifle and artillery; (*d*) loss of fire effect in dealing with their foreground; (*e*) loss of confidence.

(iv) **Extending and Decreasing Frontage.**—A reasonable balance must be struck between the different factors which influence the extent of frontage under different circumstances, special regard in every instance being given to the paramount consideration of ensuring good fire effect, especially with a view to good fire control. A sound principle when applicable is to *extend in daylight and under artillery fire*, and to *close in during darkness*. Each entrenched fire unit should therefore provide for decreasing its frontage at night. This may, if possible, be done by withdrawing into a small shoulder-to-shoulder "all-round fire"* trench at the strongest point in its allotted frontage, from which its fire will command its day firing-points, and help to enfilade any obstacles which may have been prepared to check a night attack.

(v) **Increasing and Decreasing Numbers.**—We know that men, generally speaking, will be scarce for the occupation of entrenchments, since it is one of the fundamental principles of resistance to employ as few rifles as possible in fixed

* An "all-round fire" trench is not necessarily the same thing as a redoubt or closed work, but may be a length of trench arranged for both front and back fire (see Fig. 31), and traced in the shape of the letters **L S** or **X** (Fig. 73).

positions, so that a deliberately entrenched chain of firing-points or fire-trenches, which could accommodate a platoon in an emergency, might often be allotted to a section in the first instance. Again, a small trench from which a section could develop a sufficiently powerful fire by day might not provide enough firing-points or frontage to beat off a heavy rush at night or during fog, so that ability to expand and contract in numbers is essential for entrenched fire units.

(vi) **Short Trenches.**—The shape of the surface of ordinary ground, the necessity for concealment and for providing a

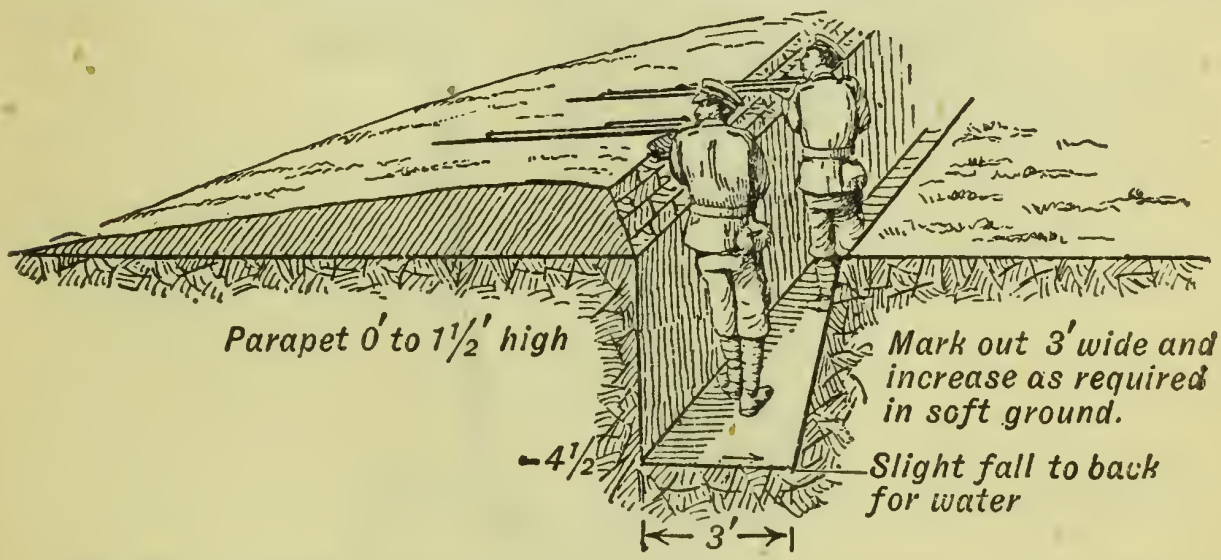


Fig. 27.—Fire-Trench with Low Parapet: Omitting Accessories.

flanking fire across the front of adjacent fire-trenches, are all points which have a tendency to suggest short lengths of fire-trench—say, not over 40 or 50 yards in one length. Such a length might, under the varying circumstances outlined above, provide cover for fire units ranging between a section and a platoon.

3. Arrangement of Fire-Trenches.—It must not be supposed, from the above examination of the principles governing the arrangement of a *single* fire-trench, that the general system of entrenchment of a considerable frontage for resistance would be a line of such fire-trenches. As ex-

plained in Chapter I., these fire-trenches, in their turn, are grouped or concentrated upon certain areas of ground chosen for their general tactical importance, and between these tactical points there are considerable intervals left for manœuvre or active operations against the enemy, and for the same power of expansion and contraction on the part of the tactical points, as has been shown to be necessary in the case of the smallest entrenched unit.

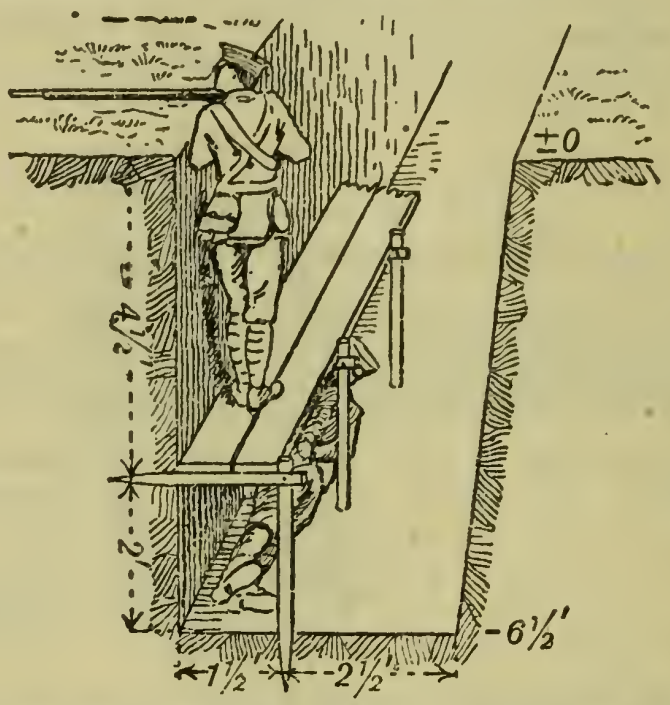


Fig. 28.—FIRE-TRENCH WITHOUT PARAPET: ALL EARTH CARRIED AWAY.

4. Types of Deliberate Entrenchments.—Some examples of normal profiles or cross-sections of typical excavations suitable for deliberate entrenchments are given in Figs. 27, 28, and 29. The actual dimensions of these trenches both in plan and cross-section may be varied within certain limits, depending upon the following considerations:

(i) The required amount of command, or height above the existing ground-level at which fire is to be delivered.

(ii) The time, labour, and tools, available for the execution of the work.

(iii) The consistency of the soil.

(iv) The facilities for concealing the finished work from view, and the relative importance of concealment.

(v) The ranges and nature of fire which the enemy may bring to bear on the work.

(vi) The shape of the immediate foreground, and whether its surface is steep, flat, or uneven.

5. Height of Parapets.—Parapets of 1½ feet command are shown in the figures of typical deliberate entrenchments for the following reasons:

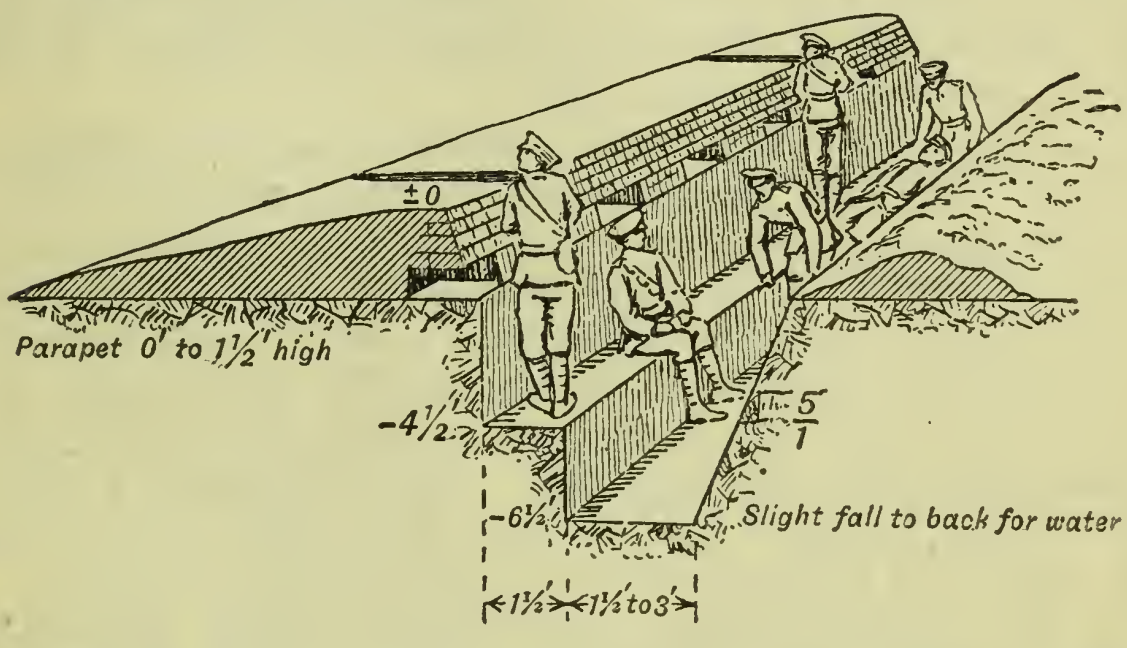


Fig. 29.—FIRE-TRENCH: NORMAL "FULL SECTION."

Note.—Traverses or recesses are omitted. Small cartridge recesses to be formed every 5 feet.

(i) That it is found in practical execution that by the time the digger has obtained the amount of earth necessary to make a bullet-proof parapet of this height, and with a gentle slope into the foreground, by excavating in a trench 3 feet wide, he will have arrived at a depth of about 3 feet and the total height of 4½ feet of cover which is suitable for the average rifleman to fire over.

(ii) That the immediate foreground must be exceptionally smooth and devoid of vegetation, etc., for a rifleman to see over it with his eye much less than 1½ feet above the ground.

6. Trenches for Firing Standing.—The following dimensions and rules, some of which have been given already, are common to all trenches from which the rifleman is to fire standing:

(i) **Parapet.**—*The top of the parapet must be bullet-proof at all ranges.* (See table, p. 195). As a practical rule, it may be remembered that *a thickness of parapet equal to the total length of the service rifle from butt to muzzle—44½ inches—is bullet-proof in any soil except wet clay.*

(ii) *The parapet and trench should be as inconspicuous as possible.* This rule usually implies either no parapet at all, or a low parapet merging gently and *imperceptibly* into the natural ground both *in front and at the ends.* The surface of the parapet, both in nature and colour, must harmonize as perfectly as possible with the nature and colour of the ground in which it is constructed, as well as with its general surroundings and background. For instance, a parapet with a smooth, level surface, straight crest-line and steep ends cannot be inconspicuous in rough broken ground.

(iii) *The interior slope of the trench should be vertical if possible.* This is in order that men sitting at the foot of the interior slope may obtain the maximum of protection against fire with a steep angle of descent. *Parapet and trench* are both included in the general term "trench," as used in this sub-paragraph (iii).

(iv) *The whole of the interior of the trench should be protected, as far as possible, against fire which will not be intercepted by the front parapet.* Such as fire, for example, which comes from the right or left, or from behind, with a steep angle of descent. This protection is provided partly by suitable siting and arrangement of the plan or trace of the

trench, and partly by the provision of additional cover suitably disposed.

(v) **Width.**—*The trench should be wide enough to admit of the passage of a stretcher without interfering with men who are firing.* In a trench without deepened communication in rear of a firing step, as Figs. 27 and 28, a clear width of 3 feet at the bottom should be given. In a trench deepened, as Fig. 29 and other examples, a width of from 1½ to 3 feet at the bottom of the passage trench will be sufficient.

(vi) **Drainage.**—*Arrangements should be made by suitable drainage to prevent the flooding of the trenches with water.* The arrangements consist in (*a*) prevention (see p. 23) and (*b*) relief, of which the former is the more important. Relief can only be provided (i) when there is ground available at a lower level than the bottom of the fire-trench, to which the water can be led by pumping, baling, or by trenches cut for the purpose, such drainage trenches being refilled in such a manner that water can find its way freely along them; and (ii) when the ground itself is sufficiently porous to absorb the water, or porous at the bottom of additional " soak-pits " sunk a few feet below the bottom of the trench at all depressions where water collects. Such " soak pits " should be dug out of the line of traffic in the trench unless they can be refilled loosely with large stones, etc., or bridged over.

(vii) *The importance of efficient drainage is so great that no deliberately entrenched fire-cover should be reported ready for occupation until this point can be dealt with.* It will be evident that, unless the ground is porous, the lowest point at the bottom of any fire-trench must be kept above the level of some outlet for the water, or drainage will be almost impossible.

(viii) **Firing Step.**—*The width of the firing step should not be greater than* 18 *inches in a fire-trench which has a deeper passage trench behind the firing step.* This is in order to keep the

passage trench as close under the cover of the parapet as possible. The back edge of the firing step requires revetment in loose soil. Where it is important to keep the whole trench as narrow as possible, it can be arranged to excavate the whole trench to the required depth, and only rebuilding firing platforms or pedestals of sacks, boxes, etc., at the exact points to be occupied by the riflemen, as in Figs. 28 and 30. Men can then get good shelter from shrapnel by standing close to the interior slope, or lying beneath the platform.

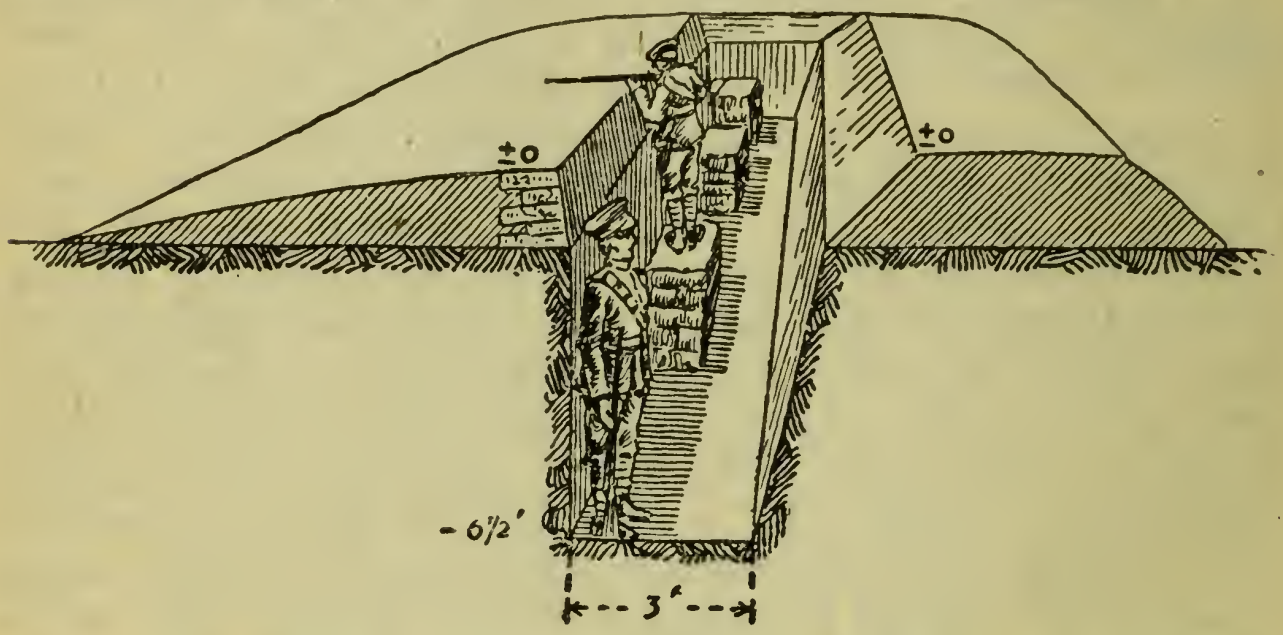


Fig. 30.—DEEP AND NARROW FIRE-TRENCH READY FOR HEAD COVER AND ROOFING.

Note.—It should be considered whether loopholes will also be useful at the back as well as in front.

(ix) *The height of the line of fire above the firing step should be about five-sixths of the full height of the rifleman when firing over nearly level ground.* Thus, for a man 5 feet 5 inches tall a height of 4 feet 6 inches would be about normal, and this height should be allowed when entrenching for others. A higher parapet can be used when firing uphill than when firing down a steep slope.

(x) *The top surface (superior slope) of a parapet should be left at the slope which will give the most effective grazing fire over the foreground from a rifle laid upon it and fired in the dark or unaimed.* A common fault when entrenching at night on ground falling to the front is to form a parapet with a horizontal top surface. Some white or visible marks kept in sight on the near foreground during construction will assist in avoiding this defect.

(xi) The average height of the top of the parapet above the bottom of a passage trench *in rear of a firing step* should be at least 6½ feet, to cover men from view and fire as they move along the trench. (See Fig. 29.)

Section 7.—Traverses and Parados for Fire-Trenches.

1. Reference has already been made to the necessity, under ordinary circumstances, for better protection than that afforded by the front parapet alone. When entrenching under fire in the presence of the enemy, there is little difficulty as a rule in deciding where such extra protection is required; but when the entrenchments are being executed in anticipation of fire uncertain as regards either direction or intensity, it is not so easy to decide what extra protection for the sides or back of each firer will be required, and whether each separate rifleman, or pair of riflemen, will require side or back protection, or whether it will be sufficient to provide such protection to the men in groups of from three to ten rifles.

2. **Traverses.**—It is seldom advisable to group a larger number than ten in an open trench protected only by the front parapet. The points to be considered in each case are as follows:

(i) Traverses not only intercept side or enfilade fire, but they limit the destructive action of shells which burst inside a trench, and intercept a proportion of the bullets from a shrapnel shell, even when it bursts straight in front, and not from one side.

(ii) By affording a sense of security, and limiting their knowledge of casualties to their neighbours behind adjacent traverses, they increase the fighting efficiency of the men still in the ranks.

(iii) On the other hand, they reduce the total number of rifles which can be placed along a given frontage in the rare event of the frontage affording an equally valuable field of fire continuously throughout.

(iv) They decrease the amount of personal direction and supervision which can be given to each rifleman when in action.

(v) They add to the labour and time required to entrench a given number of riflemen, and to the difficulties of concealing the works as a whole.

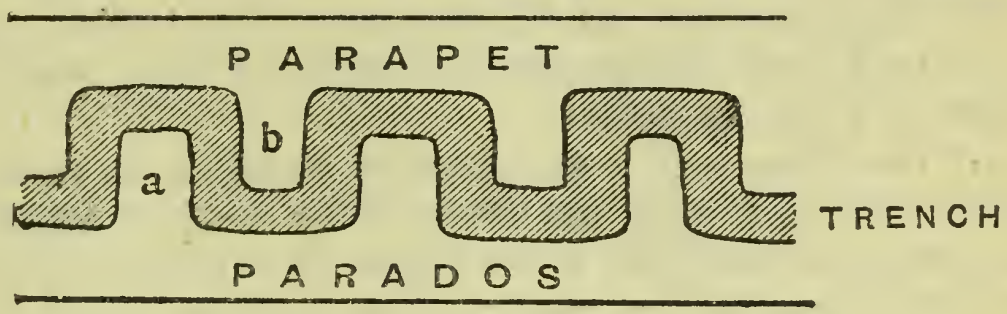
From the point of view of protection it is better to provide many small traverses than one or two large ones.

3. Protection of Flanks.—Traverses are required not only in fire-trenches, but in every situation where a relatively long line of men is liable to be swept by fire from one or both *ends* of the line, such as a line with one flank resting on the seashore and the other inland, and under fire from hostile ships. In this case the exposed flank can only seek the traverse protection of natural features along the coast-line. A straight sunken road or path used for communication from one point to another, if liable to be swept from end to end by the enemy's fire, must be traversed by means of bullet-proof screens or banks at sufficiently frequent intervals, with passage way around one or both ends of the screen. Another example of this principle is afforded by a walled enclosure used as fire-cover. If the walls are not too long they may act as traverses to each other, but if exposed to enfilade fire additional side-walls or traverses will have to be added.

4. Parapet and Parados Traverses. — It sometimes happens that a fire-trench is so liable to be caught between two fires that *both* parapet traverses *and* parados traverses

are required. Under such circumstances the arrangement would then be similar to Fig. 31.

5. Siting of Traverses.—(i) It will be evident that the siting of traverses can only be carried out on the actual ground, after the selection of the firing-points. As a general rule, advantage should be taken of existing lumps on the ground



a. *Parados Traverse*
b. *Parapet Traverse*

Fig. 31.—PARADOS TRAVERSES.

to increase the protection afforded by the traverses and reduce labour, but without making the traverses in any way obvious to an observer in front. A traverse should not as a rule be placed at a *salient* or forward angle at a change of direction in the general alignment, as the fire at this

(a) Bad position for a Traverse. (b) Traverse at an angle.

Fig. 32.—POSITION OF TRAVERSES AT A SALIENT ANGLE.

point will already be weak and dispersed, and may be still more reduced in value by the loss of frontage due to the traverse (see Fig. 32).

(ii) This point is of considerable importance. The relative weakness of fire delivered from such a salient has from the earliest times induced attackers to concentrate their efforts

upon any salients observed in the defenders' lines of fire, though at the present day the weakness of the dispersed fire from a salient can often be compensated either by the additional strength given to that part of an obstacle which is placed in front of such a point, or by the use of machine guns.

6. Construction of Traverses.—The chief methods of traversing an entrenched firing-line are described in the following paragraphs:

(i) **The Trace.**—It is sometimes possible to make a portion of the front parapet (or the interior slope of a fire-trench with no parapet) act as a traverse to another portion of the trench, merely by tracing the trench with a sufficiently wavy line—thus

This is only recommended in the somewhat rare combination of ground the natural contour of which lends itself to such a trace, *with a demand for fire to be delivered at right angles to the trace at each firing-point.* The inconvenience and loss of fire effect caused by such a trace, if the fire is required to be evenly distributed and in one given direction at a time, is apparent, and this method is more suited for communication trenches between one part of a position and another or for small isolated trenches requiring all-round fire (see footnote, p. 54).

(ii) **Natural Ground.**—Traverses are more usually and more economically provided in fire-trenches by leaving selected blocks or tongues of the natural ground untouched between the excavated firing-points. The least *width* of such a block depends upon the height and steepness of the additional earth it is proposed to pile on the top of it to match the height of the parapet, if any, *and still leave the traverse bullet-proof.* In the case of a low parapet, not exceeding 1½ feet in command, a width of 5 feet is usually

allowed for a traverse; but if the 1½ feet of additional earth is not revetted, the top thickness of the finished traverse will be reduced to about 2 feet. This thickness would only be bullet-proof to fairly oblique or long-range fire, and, where it is certain that the traverse must be bullet-proof at close ranges, it would be better to leave a ground width of 6 or 7 feet for the traverse, if it can be spared from the general fire frontage. When it is known from the first that a trench will be enfiladed by artillery, the traverses should be at least 10 feet thick.

(iii) **Concealment.**—In no case must any portion of a traverse, especially the back edge, be permitted to show above the general line of the parapet, as this renders the concealment of the fire-trench as a whole almost impossible.

(iv) **Length of Traverse.**—The length of a traverse measured back from the general line of the parapet depends upon two things:

(*a*) It must completely screen the full *width* of the trench, with a little to spare.

(*b*) It must completely screen the full *length* of the trench up to the next traverse.

Straight Trench.—In the case of a dead-straight trench, if it fulfils the conditions in (*a*) it will also fulfil them in the case of (*b*), unless a very plunging enfilade fire is delivered; but in the more usual case of a trench of somewhat curved or irregular alignment, the point illustrated in (*b*) requires careful attention, as explained in Fig. 33. This figure shows that it would be both misleading and impossible to lay down either a fixed length as generally suitable for traverses to fire-trenches, or a fixed distance apart between adjacent traverses. It is better to have the traverses too close together than too far apart.

(v) **Building up Traverses.**—Another method of providing protection by traverses is by adding them or building them up at points and intervals selected after the excavation of

the fire-trench and deep passage trench in rear. This method entails greater labour and implies a certain absence of foresight in the original plan, but is often a necessity created by the effect of fire from unexpected quarters, which is a marked feature of fighting with modern long-range weapons.

It would, however, be the usual method in the case of the alteration of existing fire-cover, such as walls, ditches, etc.,

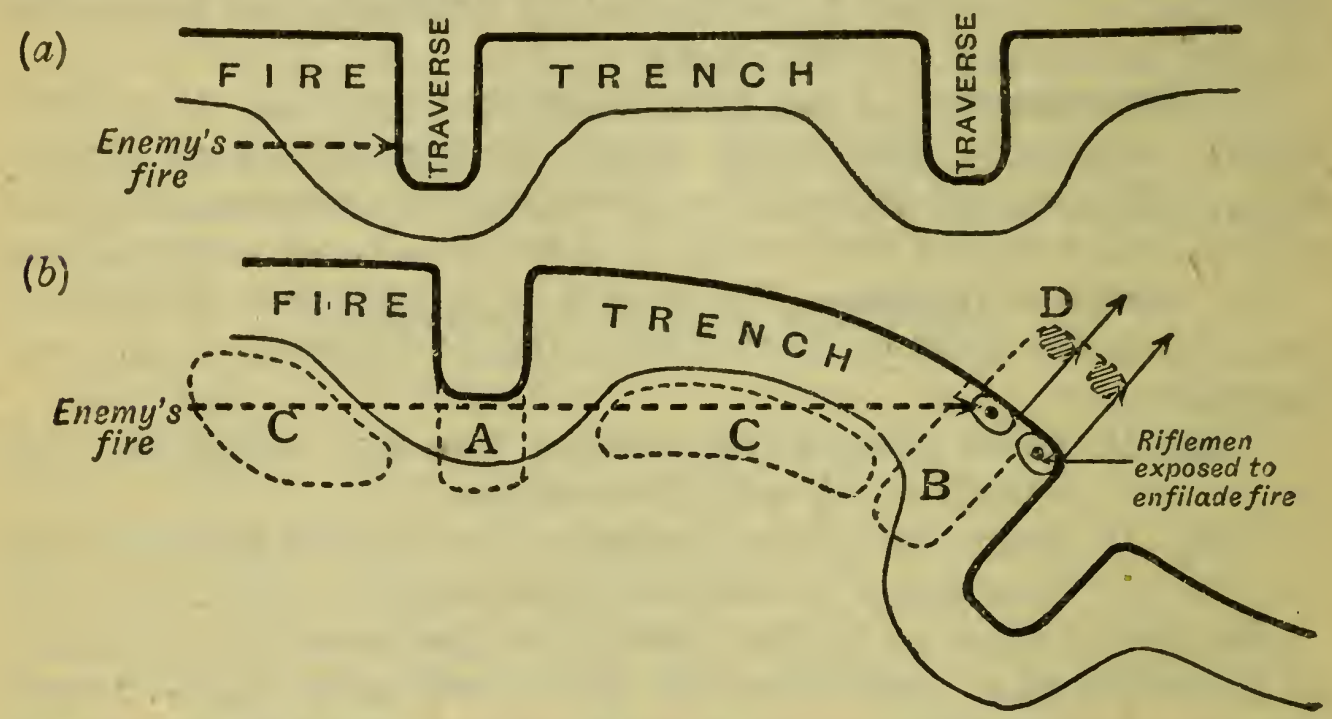


Fig. 33.—(*a*) TRAVERSES SCREENING FULL WIDTH AND LENGTH OF TRENCH FROM ENFILADE FIRE. (*b*) TRAVERSES SCREENING FULL WIDTH OF TRENCH, BUT NOT THE FULL LENGTH TO THE NEXT TRAVERSE.

Note.—The different remedies for the fault in Fig. 33 (*b*) are shown in dotted lines lettered to represent: *A*, a longer traverse. *B*, traverses closer together. *C*, parados. *D*, a recess, and the riflemen farther forward.

which require traverses. In this case each traverse is built up from the bottom to bullet-proof thickness at the top with whatever material is available. The usual method is to form a strong outer wall of boxes, tins, barrels, gabions,

sacks, or bags of earth, or merely a skin wall of planks, brushwood, canvas, sheet-iron, etc., securely anchored inwards, and to fill the enclosure with earth to the required height.

7. Firing Recesses.—(i) Traverses alone will not always afford sufficient protection to the individual rifleman against shrapnel bullets falling steeply and arriving obliquely or in enfilade, and it is then necessary, in the absence of a roof to the trench, to improve the protection further by the addition of small recesses to hold riflemen singly or in pairs. The

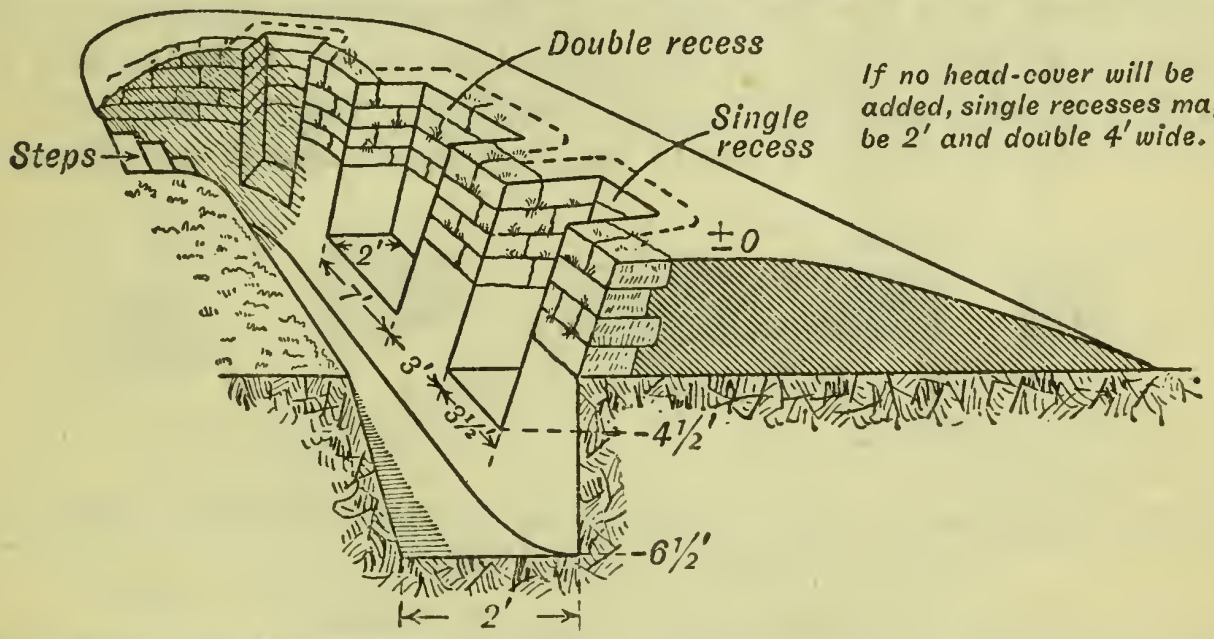


Fig. 34.—Fire-Trench, with Single and Double Fire Recesses wide enough to add Loopholed Head-Cover, as Fig. 43.

(Passage traverses, etc., not shown.)

general effect of such recesses is similar to the development of fire-cover previously illustrated in Figs. 17 and 25.

(ii) A typical sketch of a portion of a fire-trench provided with firing recesses is given in Fig. 34, in which it will be noted that deep cover is obtained close to the interior slope of the trench on the same principle as in Fig. 30; but the arrangement in Fig. 34 provides much safer cover for the rifleman when firing.

8. Method of forming Firing Recesses.—(i) There are two common methods of forming such firing recesses, according to the relative urgency between fire effect and facilities for communication at the moment of their execution.

First Method.—(ii) If fire effect is the immediate concern, or if the work is carried out at night, the entrenchment of the riflemen will commence by each man digging a pit for himself, or a pair of men may work together on a pit large enough to hold them both. When facilities become available for joining these pits up with a passage trench from one to the other, if the passage trench is cut behind and just clear of the pits, the latter will be left as recesses safely guarded against enfilade fire. The protection of the passage trench will be dealt with as already

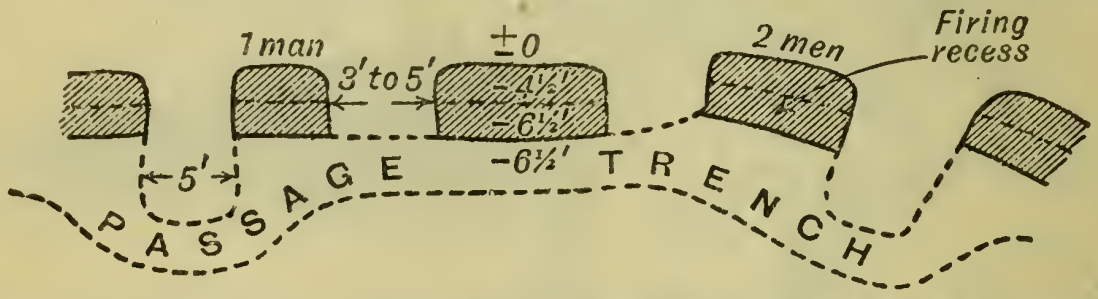


Fig. 35.—TRAVERSED AND RECESSED FIRE-TRENCH DEVELOPED FROM RIFLE-PITS.

(Original Pits are shown shaded.)

described, by leaving longer blocks of earth untouched between the pits to form traverses, and tracing the passage trenches round them with curves so easy that a stretcher can be carried round them (Fig. 35).

(iii) *Firing Steps.*—It will only be necessary to leave a firing step about 18 inches wide in each recess, as indicated by the dotted line in the figure, the remainder of the recess and the passage trench being excavated until 6½ feet of cover is obtained below parapet level. It will be noticed in Fig. 35 that even better deep cover is available for the rifleman who stands down off the firing step, as he gets the

protection of the sides of the firing recess in addition to that of the interior slope.

(iv) *Dimensions.*—It is not possible to lay down any exact dimension for each pit, as this depends so much upon the nature of the soil and the obstructions encountered. As a general rule a pit for one man, if marked out 5 feet by 3 feet at the ground surface, will afford ample standing room at a depth of 3 to 4 feet below ground, unless the soil is very loose indeed; and should the soil prove to be so stiff that the excavation can be made with nearly vertical sides, such a pit will afford standing room for two men if required. In the same way a pit 10 feet by 3 feet at the ground, and dug by two men, may under favourable circumstances be made to hold four men on emergency.

An advantage of the 10-foot pit when deepened is that it *provides sufficient space for a man to lie at full length on the firing step at the same time that another man is engaged in observation or firing.* By leaving a space of at least 5 feet of ground untouched between the pits in the first instance it may be possible later to borrow from it to increase the length of the recesses until the spaces are reduced to the minimum found desirable, usually about 3 feet.

(v) **Second Method.**—The second method of developing a recessed and traversed fire-trench is to excavate a continuous passage trench *first* along the *general* fire alignment, and then to cut the recesses forward at the exact spots selected for firing from (Fig. 36). The disadvantages of this method are that a proportion of the excavated soil in the parapet must be shifted a second time when cutting forward through the parapet, and the improvement of the actual firing-points by revetment, head-cover, and concealment, etc., is postponed longer than in the first method. It also necessitates the selection at an earlier stage of the exact spots at which to leave traverses.

(vi) It is, however, the usual method of *improving* a length

of fire-trench which was not at first expected to require the protection afforded by recesses. It has several advantages, especially with unskilled labour, as it is much quicker and easier to trace out and execute a continuous line of passage trench with such labour, and the niceties of the firing-points—the exact command, size, and finish, of each firing-point—can be left for execution by the individual rifleman at a later period under close supervision and expert advice, with the advantage of ready-made communications.

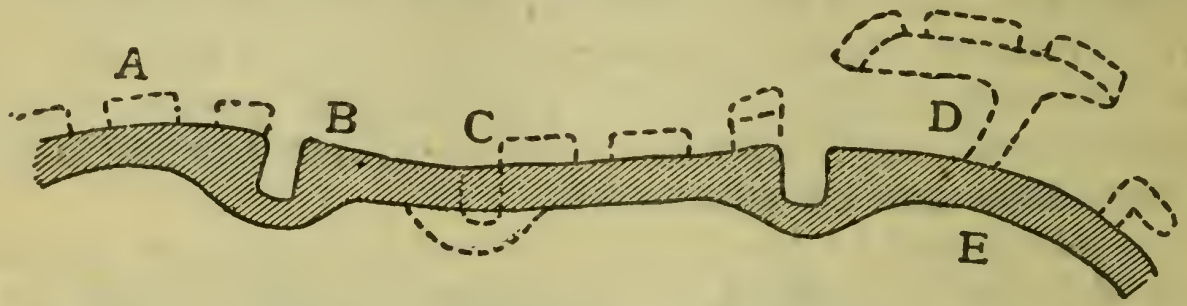


Fig. 36.—Traversed and Recessed Fire-Trench developed by Trained Riflemen from a Passage Trench executed by Unskilled Labour.

Note.—In the figure the shaded portion represents the passage trench as originally executed, the dotted outlines its final development by the riflemen, excepting the shelter recesses.

The portion *A* was recessed in the usual manner; the portion *B* was not considered of any value as a firing-point, and was developed into cover for supports with a shelter recess (Fig. 52). At *C* an extra traverse was demanded. At *D* the alignment of the passage trench was rejected, and a fresh trench cut farther forward. The portion *E* was reserved as cover for supports, etc., and was roofed over.

(vii) This method also lends itself to a better system of careful drainage of the trenches, facilitates progress with shelter for supports, and the concealment of the passage trench-work generally. It would probably be the method adopted in the deliberate execution of provisional entrenchments some time before they were likely to be required for use, or at a season of the year when the foreground

vegetation precluded a proper examination of the field of fire.

9. Parados.—(i) It has been mentioned that a parados is a parapet constructed for the special purpose of protecting the backs of men who are firing to their own front. Though not always necessary, a parados adds greatly to the sense of security. It must, of course, be bullet-proof. It is often useful as a background screen to prevent the heads of men who are firing from showing up against the sky when viewed from lower ground. A parados is a necessity in the case of a small isolated ring or closed group of fire-trenches liable to attack from any direction—such as a field redoubt, a group of trenches around a wayside railway-station, *or any two trenches placed back to back, both within range of the same shot,* and not provided with any efficient natural screen which will prevent shots which just pass over the front trench from striking the occupants of the second trench in the back.

(ii) *A parados should be as close as possible to the backs of the men to be protected,* not only for the reason that men press close against the interior slope of the fire-trench, but because the reverse fire against which it is intended to guard will probably arrive from long range with a fairly steep angle of descent and great searching power. Thus in all situations where a parados is an urgent necessity, the *width between the interior slope of the parapet and the interior slope of the parados must be reduced to a minimum,* and the interior slope of the parados should invariably be faced with soft material to prevent ricochets from bullets and splinters.

10. Parados Traverses.—A parados traverse is a traverse of a similar nature to those already described, but projecting *forwards* from the parados instead of *backwards* from the parapet (see Fig. 31 at *a*). They are employed when the chief danger is apprehended from *reverse* fire under the

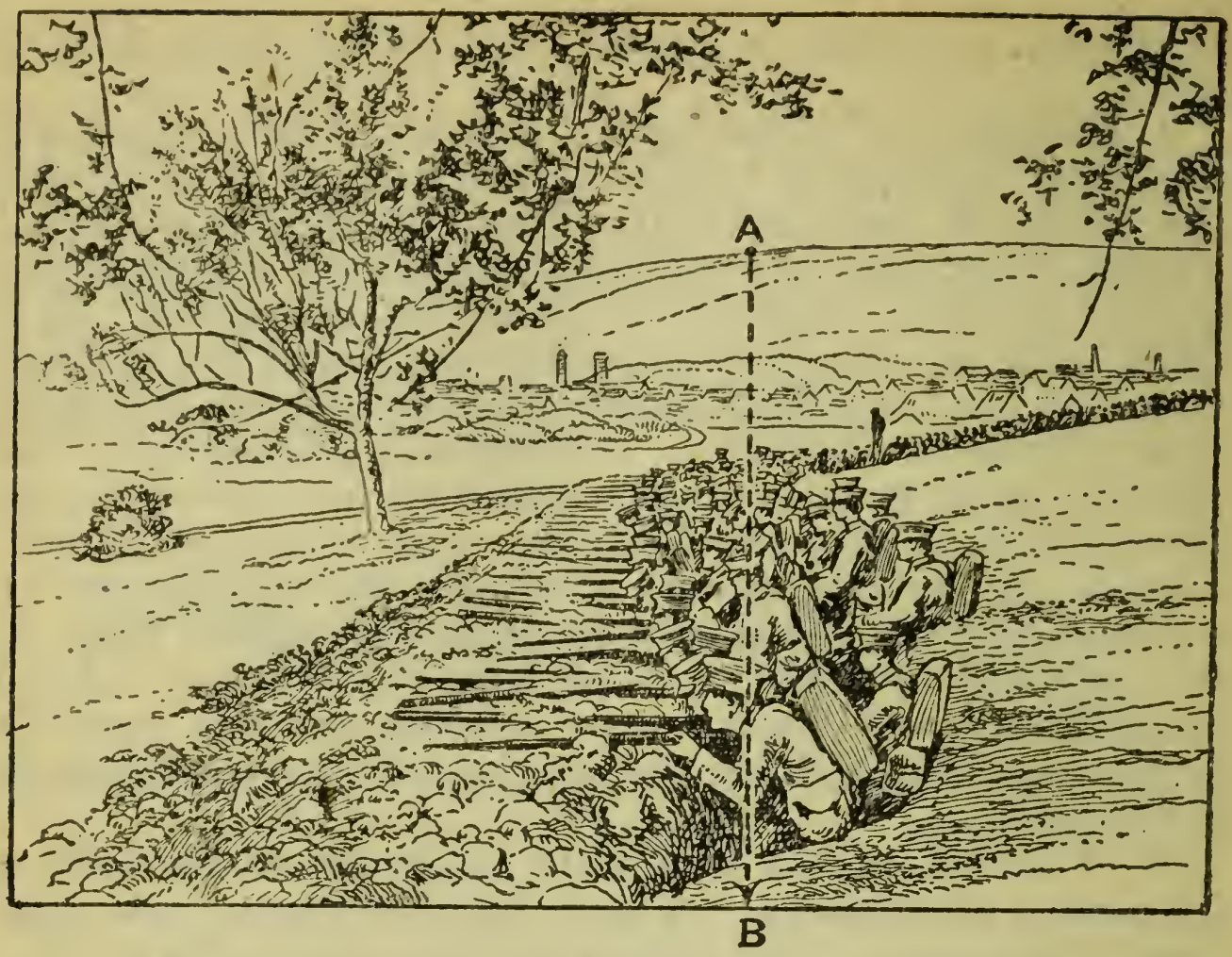


Fig. 37.—EXAMPLE OF FAULTY ENTRENCHMENT.

Obvious faults in above fire-trench are—

(i) Too many riflemen crowded in a straight line without proper "traversing," or back cover.
The enemy's artillery would seek for point *A* on the distant hill, and would sweep out the alignment *A*—*B* with shrapnel fire, taking the trench in enfilade, inflicting heavy loss and rendering it untenable.

(ii) The top, or superior slope, of the parapet is too horizontal. It will be noticed that the rifles do not lie parallel to the slope of the foreground, and cannot sweep it with a good grazing fire at night.

(iii) There is no deepened passage-way behind the riflemen for communication along the firing-line.

(iv) The surface of the parapet has not been treated so as to harmonize in appearance with the adjacent ground surface, and is not invisible from afar.
The remedy is indicated in Figs, 25, 31, 32, etc.

circumstances above described, such as, for instance, on *that side of a closed ring of fire-trenches, which faces away from the enemy's artillery*, and is only considered liable to attack by riflemen who might work round the ring at night.

Section 8.—Head-Cover.

1. Head-Cover.—Protection or cover from frontal or oblique fire for the heads of riflemen in the act of firing *over* a parapet or other cover not more than breast-high is called head-cover. It follows, therefore, that some form

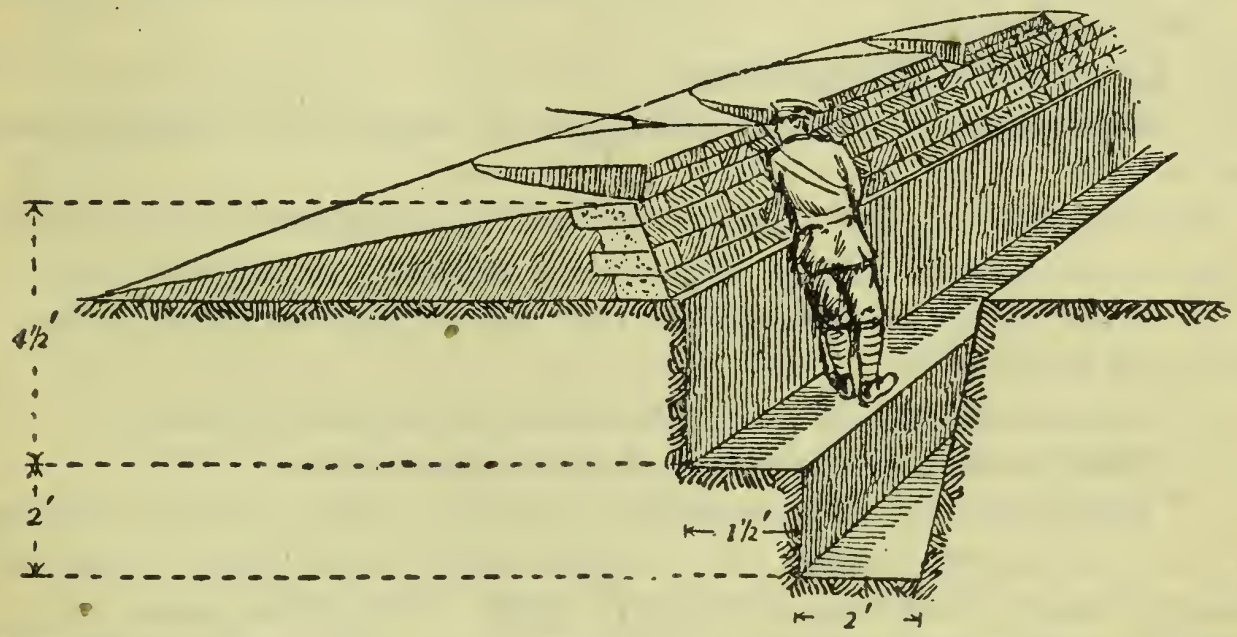


Fig. 38.—HEAD-COVER: PARAPET WITH NOTCHES, OR RIFLE EMBRASURES.

of hole or opening must be left or made through the head-cover to enable the men to fire. Such an opening is called a *loophole* if it does not extend to the top of the *head-cover*, and a *notch*, or rifle embrasure, if it is open at the top (see Fig. 38).

2. Materials.—When dealing, on p. 18, with the most hasty forms of fire-cover which could be improvised in the attack, or for resistance at notice so short that deliberate

excavation was impossible, a list was given of materials and articles likely to be useful for the purpose. All the articles mentioned then would be useful when deliberately adding head-cover to firing-points; but in their absence head-cover may have to be formed with earth alone, with a few sticks, etc., to bridge across the top of the openings left for loopholes, and to support the head-cover above the loopholes.

3. Traverses.—When head-cover is added to firing-points, the protection afforded will be more complete if all traverses are also raised in height to match the height of the head-cover.

4. Loopholed Head-Cover.

(i) **Advantages.**—The advantages of loopholed head-cover are—

(*a*) Protection for the head and shoulders of the rifleman in the act of firing, especially against shrapnel.

(*b*) Increased accuracy of fire resulting from a greater sense of security.

(*c*) Concealment of movements behind the cover.

(ii) **Disadvantages.**—The disadvantages are—

(*a*) Difficulty of effectively concealing firing-points, owing to the increased height above-ground of the cover, and the conspicuous shadows resulting from the presence of loophole openings or notches.

(*b*) If the head-cover is knocked about by the enemy's fire, shooting from the firing-points may be seriously impeded.

(*c*) Reduction in the number of rifles which can be crowded into line in an emergency.

(*d*) Inconvenient for leaving a trench to meet the enemy with the bayonet.

(*e*) Length of time required to construct, and quantity of extra materials necessary.

(*f*) Can only be set out and constructed during daylight

without serious risk of obtaining a poor view and control over the most important points in the field of fire, and in any case, if constructed by unskilled riflemen, each loophole is liable to many defects, tending to impair the effectiveness of fire.

5. Concealment.— (i) When facilities exist for constructing loopholed head-cover, and a decision is required as to which firing-points should be so protected, it must be remembered that invisibility is of the utmost importance at long ranges and from points likely to be occupied by the enemy's artillery and artillery observers.

(ii) The concealment of head-cover on grass-land is extremely difficult, unless the greatest care is taken to strip and save the turf, and to relay the strips in the same relative position on the finished work, without gaps, in the fewest number of pieces and with the least damage and discoloration to the foreground.

(iii) **Loopholes.**—The effective concealment of loopholes without impairing their efficiency requires the highest skill. In order to obtain a satisfactory effect, it is most advisable to entrust the whole of a trench, or group of trenches, to a selected party of proved skill, and not to allow each rifleman or workman to follow his own fancy.

(iv) **General Effect.**—The effect of measures for concealment must whenever possible be inspected carefully, by those in charge of the work, from the enemy's point of view; and, in considering the efficacy, the whole scene of which the entrenchment is a feature, together with the background into which it should merge as a natural feature, must also, when possible, be studied from several points of view.

6. Protection.—Increases in importance as ranges diminish, so that, if there is serious doubt on the question of effective concealment of the completed head-cover, it may be advisable to defer its construction until it is certain that

further attempts at concealment are of less value than the protection afforded by head-cover. Materials such as bags of gravel or earth, large stones, and steel loophole plates, if available, should be distributed in the trenches in readiness for such a moment.

7. Loopholes.—(i) **Dimensions.**—The size and shape of each loophole is governed by the following considerations:

(*a*) The extent of ground to be covered by fire.

(*b*) The bullet-resisting power of the materials used.

(*c*) The necessity for concealment after construction.

(*d*) The width of foundation available beneath the head-cover.

(*e*) That the rifleman should be able to get his head well forward for view and overhead protection.

In each case the loophole should be of the smallest dimensions that will fulfil these requirements. It is obvious, therefore, that a different size and shape of loophole would be required for such cases as (*a*) a field of fire limited to 200 yards along a level road in a narrow cutting, and (*b*) a field of fire of 2,000 yards of open country, the first 400 yards down a steep hill, the remainder uphill.

8. Loopholes in Plan.—(1) There are three typical arrangements of single loopholes in plan (Fig. 39), and the points which influence the selection of a particular type are as follows:

Type A gives the best view with the least movement of the eyes. It is the most difficult to conceal on account of the wide opening in front. It is quite unsuitable for hard materials, such as brick or stone, which might deflect bullets or splinters into the observer's face by ricochet. Its use is principally confined to *lookout or observation loopholes in earth*. These can be made of a height very shallow compared to a rifle loophole, and this type is then not so difficult to conceal.

Type B shows the smallest opening in front, and is easier

to conceal. It requires the greatest amount of movement of the head and body to see or fire over the foreground. It is the most suitable form where the head-cover is of good bullet-stopping material, and so relatively thin from

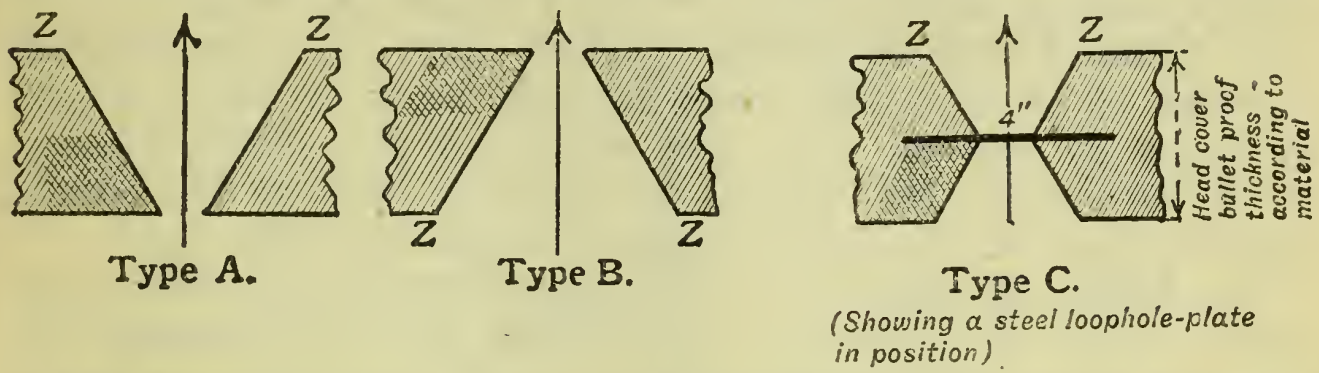


Fig. 39.—ALTERNATIVE ARRANGEMENTS OF LOOPHOLES IN PLAN.

front to rear in plan, as in a masonry wall, etc. It is sometimes used for earth loopholes, where it is of great urgency to keep the front opening as small as possible, and where the arc of fire required to right and left is also small.

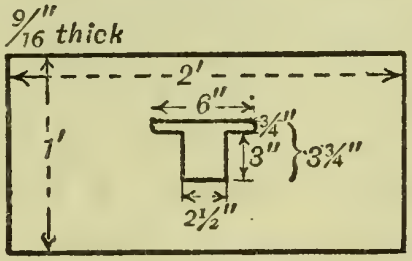


Fig. 40.—STEEL LOOPHOLE PLATE.

Type C is a compromise between A and B as regards facilities for view and concealment, but can be adapted to give a larger arc of fire combined with a smaller interruption in the bullet-proof thickness of the cover as measured between the points Z—Z in each type. It is the type usually suitable for earth loopholes when revetted with sand-bags, turf, or boards. It is also employed in masonry walls

which are too thick for Type B, but in this case the outer half of the loophole should be formed in steps, and not with a straight splay, for reasons already given. This type lends itself best to the support of a steel loophole plate, when available (Fig. 40 and Fig. 39, Type C).

9. Bullet-Proof Materials.—When only a very limited number of good bullet-proof articles, such as large stones or bags of gravel, etc., are available for strengthening earth loopholes they should as a rule be used at the points cross-shaded in the above types of loopholes (Fig. 39).

10. Angle of Splay.—(i) The angle of splay given to the above types of loopholes, apart from the requirements of peculiar sites, is usually limited to 60 degrees as regards Types A and B; but in Type C, if steel loophole plates, bags of shingle, or other thickness-reducing materials, are available, it is quite easy to arrange for 90 degrees splay, and so obtain the full advantages to be derived from the great ranging power of modern rifles. A convenient width at the narrowest part in plan of the above loopholes is 4 inches, but the actual width necessary should always be obtained by placing the rifle in the two extreme positions required.

(ii) In the case of a steel plate the width of the cut in the plate may be reduced to 3 or even 2½ inches, for the rifle is less than 2 inches wide. *Below 2½ inches it is not possible to obtain the stereoscopic use of both eyes which is necessary for judging distances.* Loophole openings in steel plate are often provided with a narrow slit about 6 inches long by ¾ inch deep, level with the top of the opening, which is otherwise of minimum size—say, 2½ by 3¾ inches high—for the purpose of increasing the facilities for viewing a large arc of ground without undue exposure to fire.

It will have been noticed in Fig. 17 that a rifleman does not shoot naturally or conveniently directly to his front—*i.e.*, along a line at right angles to the straight line between his shoulders—but along a line making an angle of about 20 to

30 degrees to the left of the direct line to his front, in the usual case of a man firing from the right shoulder (Fig. 41). This is the natural consequence of the fact that his shoulder is farther than his eye from the vertical axis of his body when standing upright, so that when shoulder, eye, and the

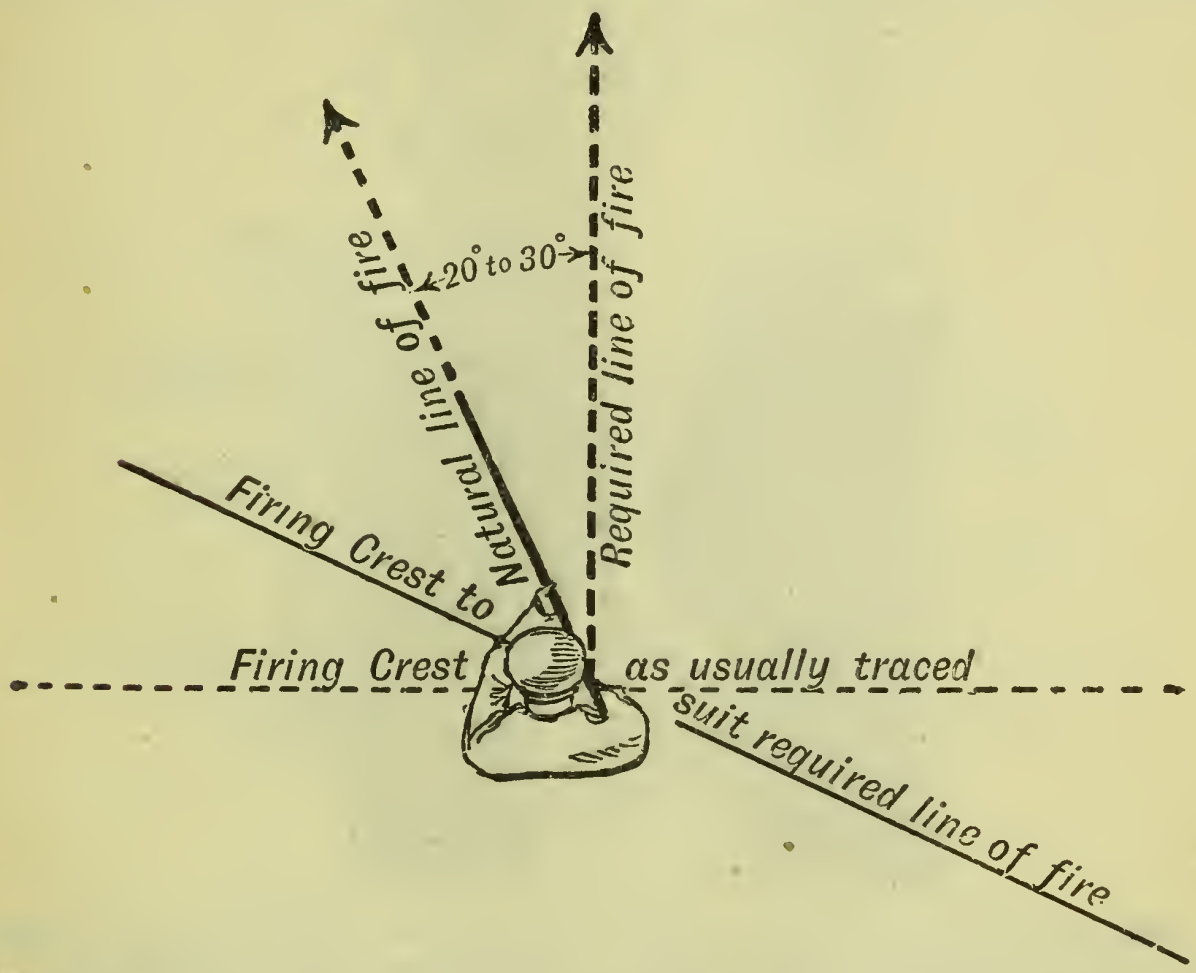


Fig. 41.—NATURAL LINE OF FIRE NOT TO "THE FRONT."

sights of the rifle, are all in the same alignment, his body is necessarily slewed round to a certain extent—usually called half-right in musketry instruction, but in reality less than 45 degrees.

(iv) **Effect of Excitement upon Fire.**—The above has an important bearing upon the general trace of fire-trenches, the alignment of the front edge of firing recesses, and the

design of loopholes through head-cover; for men in the excitement of action and uncertain of their target have a

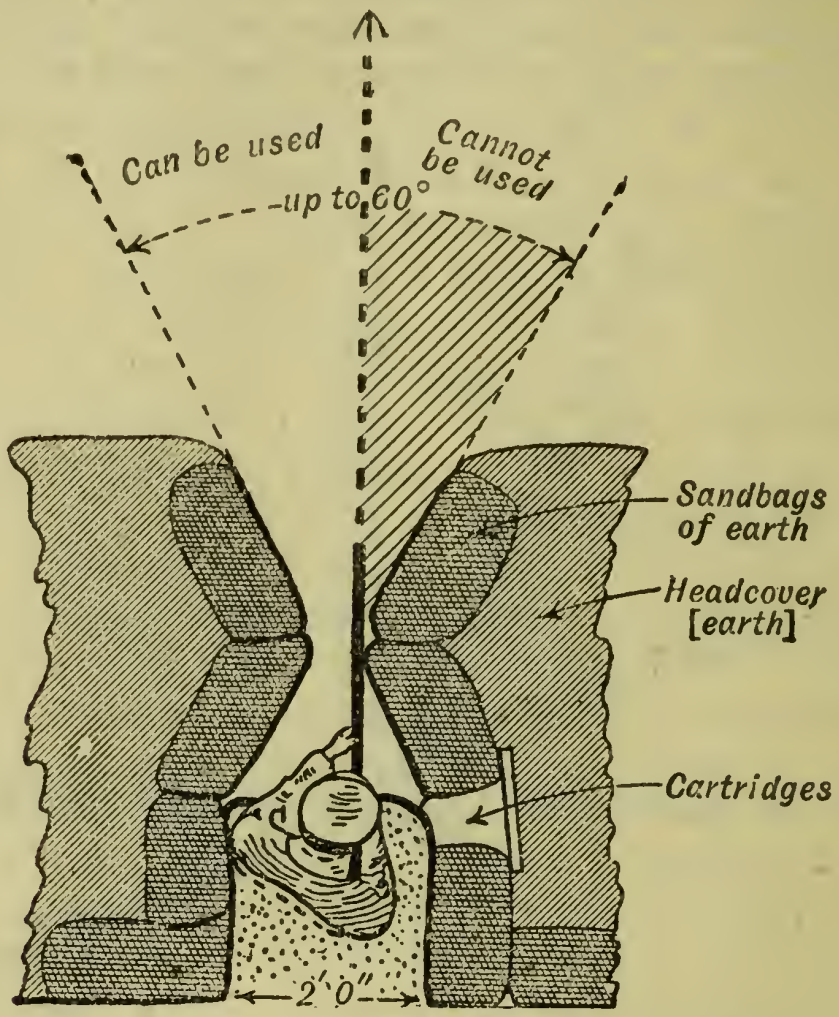


Fig. 42.—FAULTY EXAMPLE OF SAND-BAG AND EARTH LOOPHOLED HEAD-COVER AT A RECESSED FIRING-POINT.

Fig. 42.—*Example to be avoided.* Sand-bag and earth loophole added to a recess only 2 feet wide, so that the rifleman cannot fire at all to his right front—a common mistake. *A recess 2 feet wide is only suitable for firing over an open parapet or through a loophole with not more than* 30 *degrees splay, entirely to the left front.*

natural tendency to adopt the most convenient pose, and will fire, not "straight at their front," *but about* 20 *to* 30

degrees to the left of their front, and this should have been corrected automatically in the original trace of firing-points intended to bring fire to bear naturally and easily

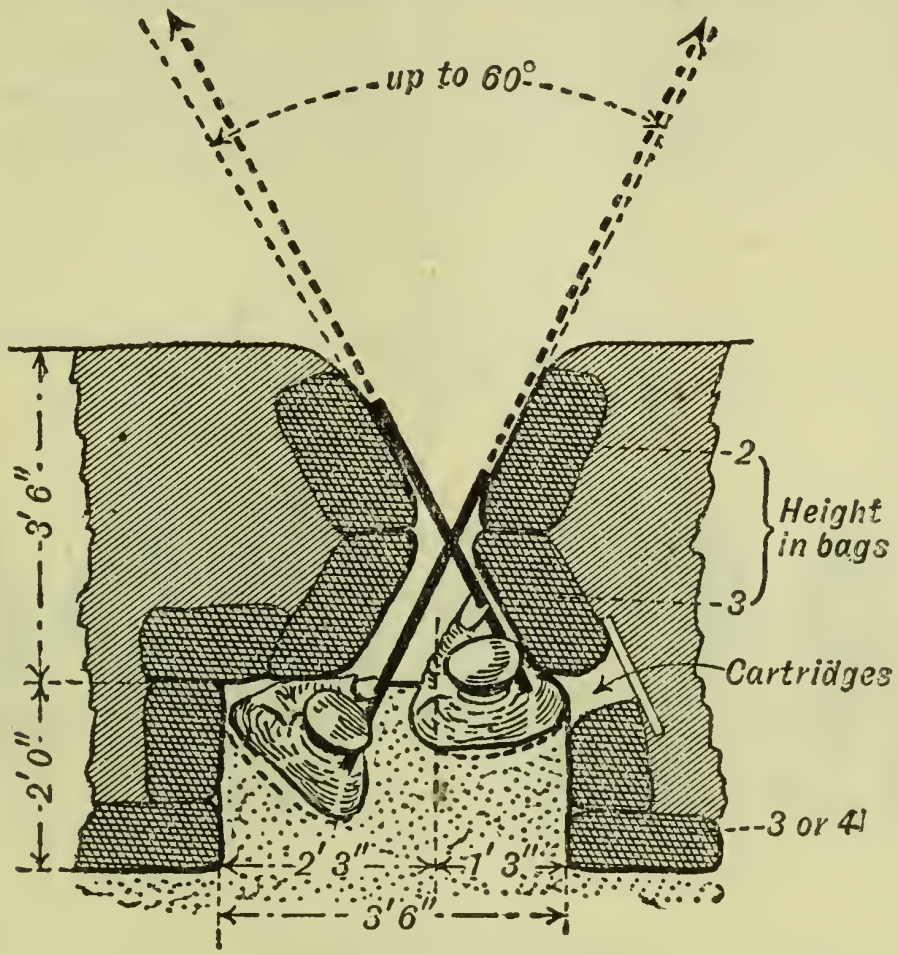


Fig. 43.—FAULTS PARTLY CORRECTED.

Sand-bag and earth loophole added to a single firing recess 3 feet 6 inches wide, of which 2 feet 3 inches lies to the left of the centre line of fire, so that the rifleman (shown in alternative positions) can fire 30 degrees to the right or left of the centre line.

upon certain alignments, especially in the dark, if the rifleman is to derive the full benefits of his entrenchment.

In practice this point is seldom attended to until the construction of loopholes is undertaken, when the difficulty and inconvenience of slewing the body round suffi-

ciently to fire much to the *right front* is immediately apparent if the loophole has been made with the same amount of splay on each side of the centre line. This difficulty is often accentuated also by the fact that the *bulk* of the body is on the *left* side of the rifle, and a loophole carelessly placed in the *centre* of a small recess or too close to a traverse or cross-wall of any nature, makes it

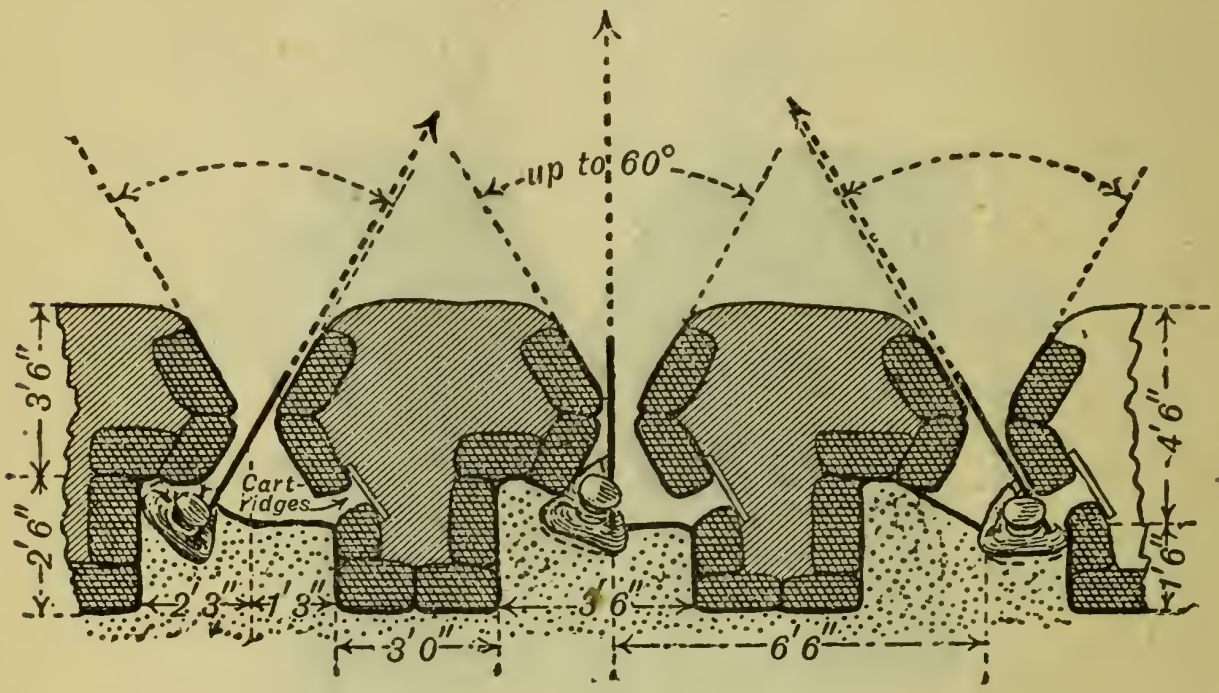


Fig. 44.—Plan of Sand-Bag and Earth Loopholes Properly Set Out.

Single firing recesses, as in Fig. 43, but cut forward on the left-hand side to provide better body-cover and a more natural attitude for the rifleman when firing. Twenty-five to thirty sand-bags per rifle are required for this.

a physical impossibility for the rifleman to fire to his right front. These points are illustrated in Figs. 42, 43, and 44.

11. Loopholes in Section.—No dimensions can be given which will be suitable for loopholes in all materials. In each case *the rifle must be aimed, with the sights properly adjusted, at both the nearest and farthest points between*

the extreme right and extreme left of the selected field of fire, and the height of loophole opening arranged accordingly, and with due regard to the thickness of material to be used in the head-cover. Even with these precautions it may sometimes be found that, although the *line of sight* is clear in every direction, if the rifleman removes the bolt and looks through the bore with the rifle sighted for extreme elevation, that the bullet would strike the roof of the loophole, and an additional allowance of height must be made accordingly to clear the *line of fire*.

12. Common Forms of Loopholes.—As the most difficult loophole to make well is probably also the commonest form—namely, through earth head-cover and with sandbags—two examples are given in Figs. 45 and 46 of the average form taken by such loopholes in section, whether of Type A, B, or C in plan, according to the slope of the foreground and the extreme elevation and depression desired.

13. Various Forms of Loopholes.—(i) Loopholes formed of any material better than earth for resisting bullets present relatively small difficulties in construction, and a study of Figs. 39 and 40 will show the service steel loophole plate, and how it is placed in a loophole of Type C. Shingle or gravel loopholes are shown in Fig. 47, which also illustrates the use of a light screen to conceal the shadow cast by a loophole, and to prevent light from showing up the position of a loophole from behind. The screen is supported at the general slope of the exterior of the head-cover by a piece of stick, etc., which is pulled away from inside when lowering the screen. Where screens are not made, a ball of grass, straw, rags, a haversack, etc., must invariably be kept in each loophole which is not in use, to blind it as above described.

Notes to Figs. 45 and 46—Parapet.—For troops fully trained to shoot from behind cover, the line *G—F* should be followed for the interior slope of the trench, and the value of the cover,

both for fire and protection, will be increased. Small recesses for cartridges can be formed on the right of each loophole (see Fig. 43).

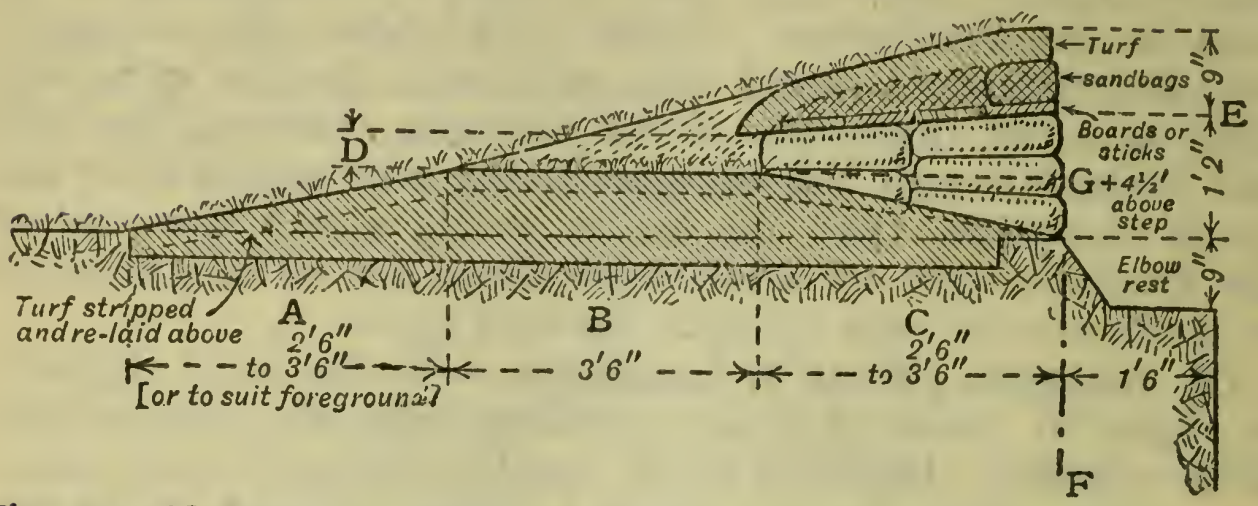


Fig. 45.—Typical Section of Earth and Sand-Bag Loophole on Level Ground (Grass): Low Parapet. (Scale, 1 : 24.)

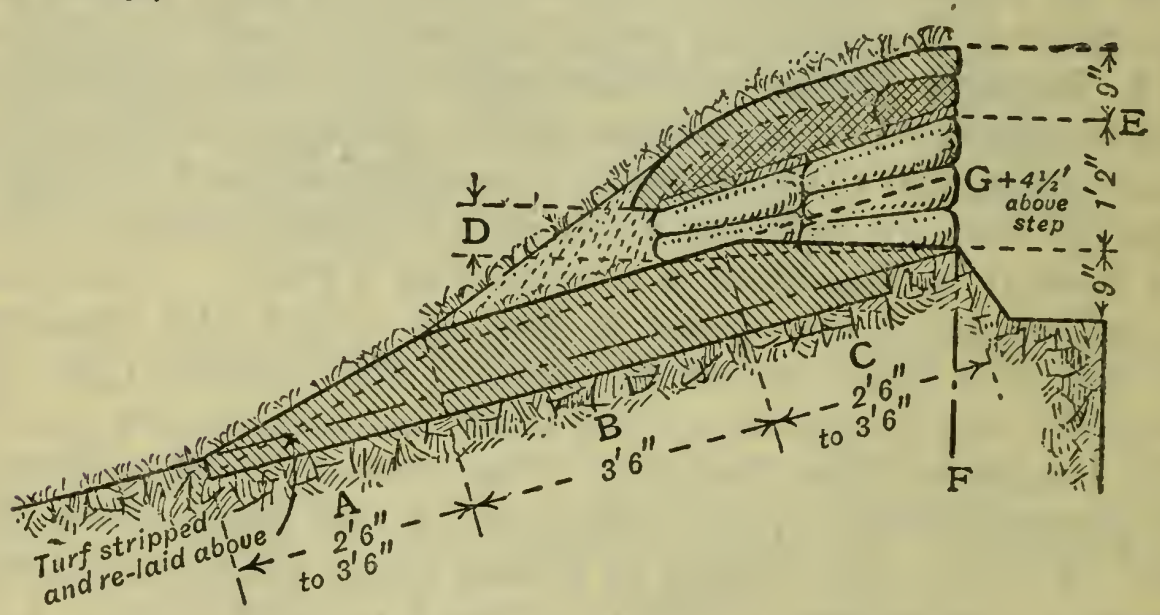


Fig. 46.—Typical Section of Earth and Sand-Bag Loophole on Steep Ground (Grass): Low Parapet.

The point *G* indicates the position of the "firing crest" when the field of fire is restricted to *close ranges only*, and is the point to which the height above firing step (average 4½ feet) should be measured at *all ranges*

Loopholes.—In Fig. 45, as the ground is level, only sufficient depression of the rifle need be arranged for to strike the ground a few yards ahead. Elevation must be provided, according to the limit of range, by adjusting the slope of portion *C* and the height *D*. It is useful slightly to raise the point *E*, to improve the light over the sights, and to allow the head to enter for cover against shrapnel. In both figures portion *B* must be bullet-proof at the closest ranges. It will be sufficient if portion *C* is bullet-proof at ranges which would deliver a bullet at an angle of descent equal to or steeper than the slope given to *C*. (In Fig. 45 the slope of *C* is about 10 degrees, or equal to the angle of descent of a bullet fired at about 2,000 yards, and a thickness of 2 feet 6 inches would be quite safe). The portion *A* must be finished with a slope which merges very gently into the foreground.

In Fig. 46 sufficient depression must be given to sweep the foreground. There is danger of piling the earth during excavation, especially at night, so that portion *B* becomes nearly horizontal, and no firing possible down the slope. See Fig. 37 (ii).

It is often necessary to provide for distant or long-range fire as well, and the height *D* and slope of portion *C* must be adjusted with great care to suit the field of fire.

If a limited supply of small stones or gravel is available, it should be disposed at the portions cross-shaded in the sections given. If sticks are used to support the earth above the loophole, they should be strong, and not sag under the weight. A layer of grass, etc., or an unstitched sand-bag laid over the sticks will prevent earth from falling through. The sand-bags should be about three-quarters filled, laid in position with neither the "choke" nor the "seam" exposed, and beaten firmly into the required shapes.

(ii) **Continuous Horizontal Slits.**—Loopholes are sometimes made in the form of a series of continuous horizontal slits bridged over with rails, planks, etc., supported at intervals. The advantages of this type are that men can be placed closer together should a dense firing-line be necessary, and a wide field of view and fire can be obtained. The disadvantages are serious—namely, the extreme difficulty of

concealing such a loophole; greater exposure to fire from right and left, and the unusual strength of materials necessary to carry the weight of the head cover over long spans without sagging.

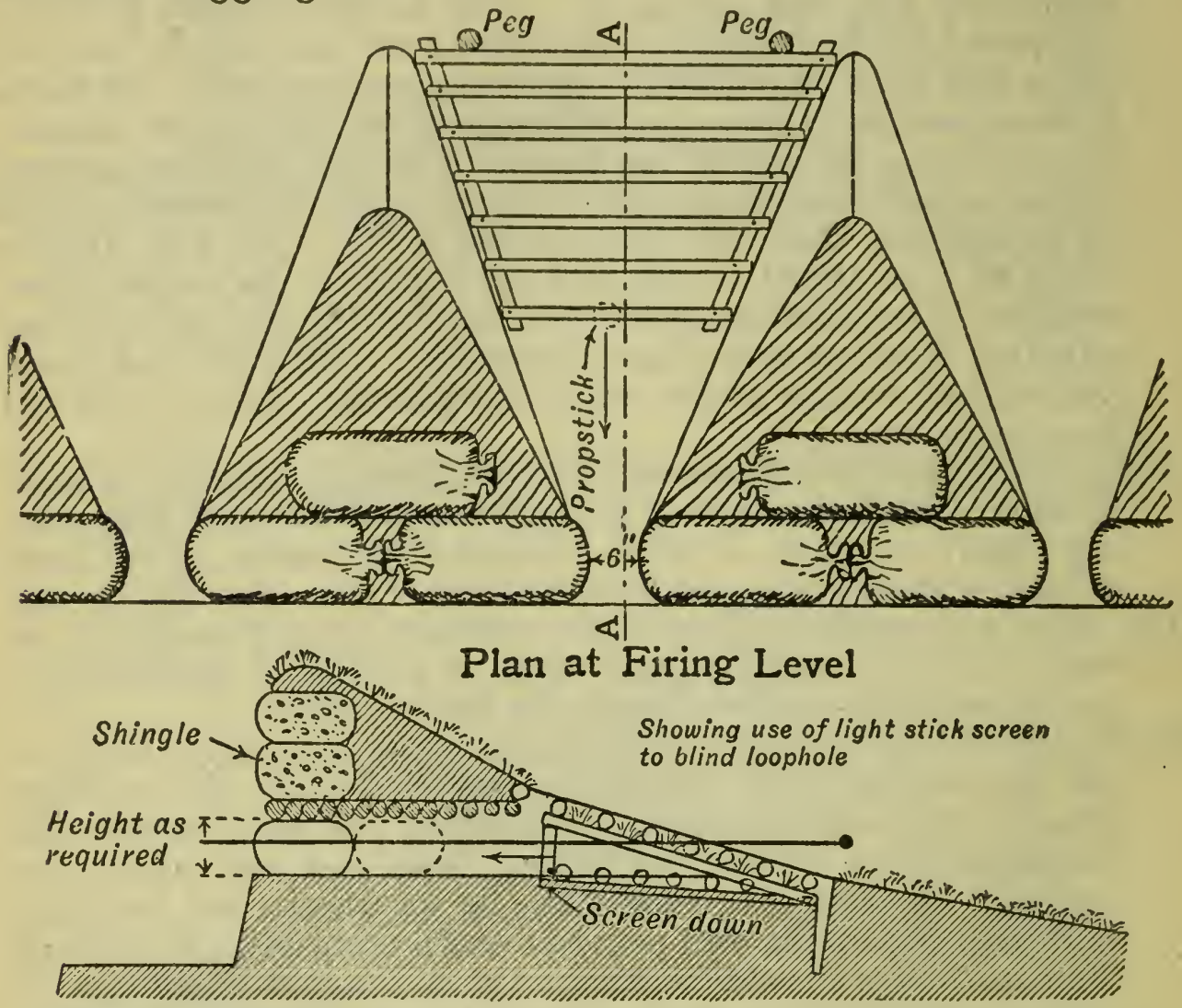


Fig. 47.—SHINGLE LOOPHOLE (TYPE A): SECTION AT A.A.

(iii) **Box Loopholes.**—When a few boards, a hammer, nails, and saw, are available, the difficulties of getting satisfactory loopholes with sand-bags, turf, etc., made by men ignorant of the use and powers of the rifle, can be overcome by making funnel-shaped loophole boxes of dimensions safe for all ordinary situations. These boxes can then be set

on the parapet by one skilled rifleman, and built in or covered over by unskilled labour. An example of a box loophole of this nature is shown in Fig. 48.

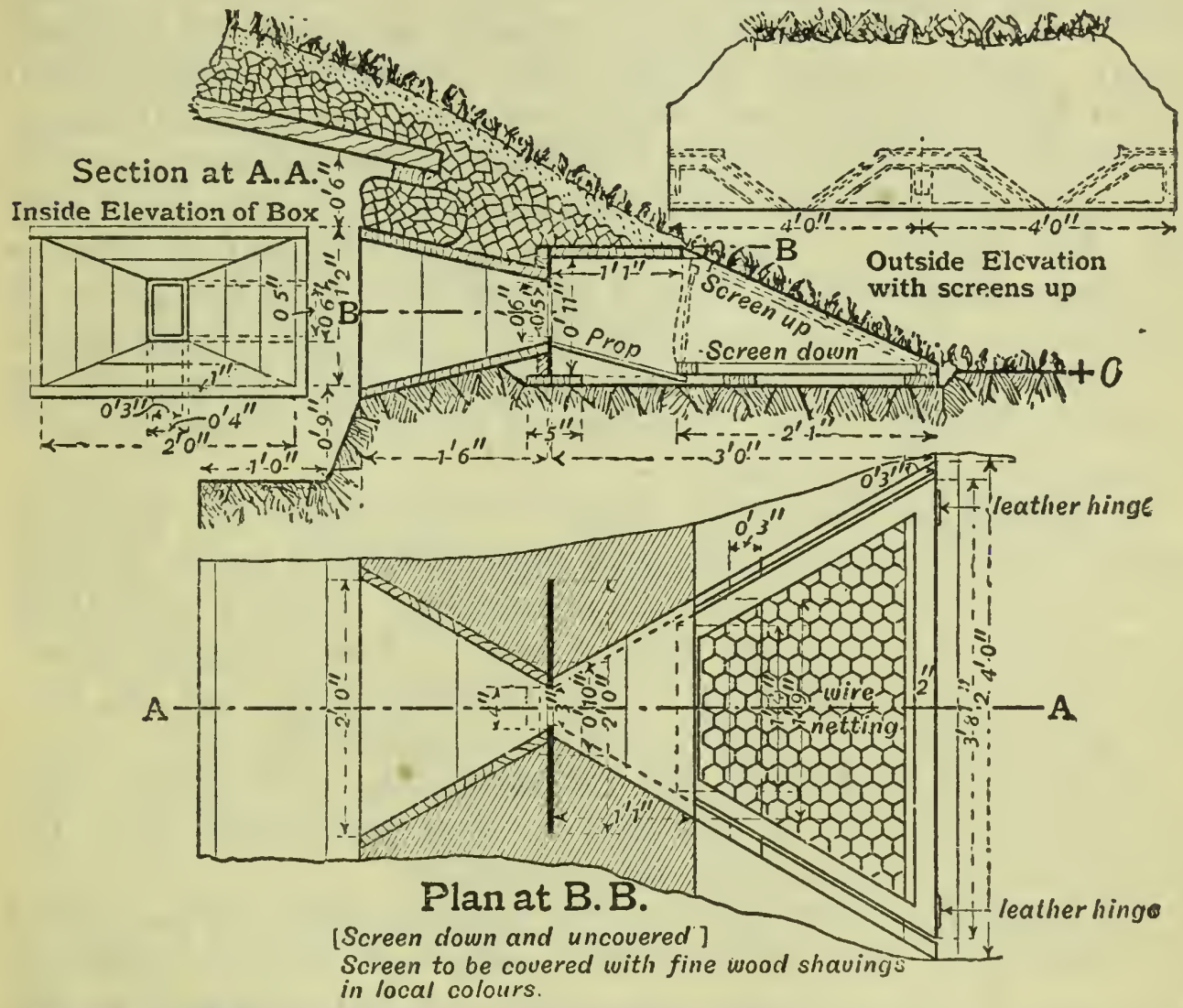


Fig. 48.—Box Loophole, for Use with Service Loophole Plate, Revetment Tray and Screen.

Section 9.—Overhead Cover.

1. If the necessary materials can be obtained, overhead cover should be provided under all circumstances which warrant the provision of loopholed head-cover in deliberate entrenchment. Overhead cover adds to the protection

given to the riflemen by head cover by shielding him from shrapnel bullets, splinters, or hand grenades, arriving with a steep angle of descent, as well as from view of observers in aircraft, by providing some kind of roof actually *over* his head. The circumstances, as regards facilities for concealment, which would warrant the provision of overhead cover have already been examined when dealing with head-cover (p. 75), and the only additional requirements now are the *materials* and the *extra time* necessary to provide a roof for the rifleman. The provision of the former is often a serious consideration, but if an effective rifle-fire is to be maintained *after the position of the defenders' firing-points has been definitely discovered and accurately ranged by the enemy's artillery*, the provision of overhead cover becones of the utmost importance.

2. Extent of Overhead Cover.—The extent to which a firing-point is roofed over will depend chiefly upon the size and strength of the materials available. It may vary from a small hood projecting back a foot or two from the head-cover, such as roofed-in firing recesses (Fig. 44) up to a complete roof from head-cover to parados (Fig. 51).

3. General Directions for Construction.—Whatever form of overhead cover is adopted in any particular case, the following directions must be observed.

(i) **Caution.**—Overhead cover loaded with earth should not be constructed by men who have not received instruction in the elementary principles of carpentry and the strength of materials.

(ii) **Head-Room.**—Sufficient head-room must be left above the top of the loophole openings inside to permit of the use of the rifle at the extreme depression required. Nine inches is usually sufficient, but this must be tested at each firing-point.

(iii) **Thickness.**—The thickness of cover should be sufficient to keep out shrapnel bullets and shell splinters. No attempt need be made to exclude unburst shells, as the

necessary thickness would be prohibitive. Rifle bullets also, unless fired from a greater height at close ranges, need not be considered. A thickness of 3 inches of shingle, 6 inches of gravel, or 9 to 12 inches of soft earth, supported in a suitable manner, will be sufficient.

(iv) **Supports.**—The supports must be strong enough to take the weight, and the destruction of one portion should not involve much damage to adjacent portions. Earth is very heavy, and may be taken to average 1 hundredweight per cubic foot. Supports must either be driven down to very firm ground or must rest upon "sole plates"—namely, pieces of stiff board, etc.—which will not allow the posts to sink when loaded, and must be well strutted if necessary.

(v) **Posts.**—If posts are used as supports, they should not obstruct the passage along the trench, nor inconvenience men on the firing step. They should be utilized as far as possible to assist in the revetments of interior slopes of the trench, and of the firing step.

(vi) **Rafters.**—The ends of rafters, planks, etc., which rest *on the edges of excavations*, must be given a firm and level bearing, so that the weight will not cause the sides of excavations to collapse. It is usually advisable to allow for a bearing of at least 18 inches beyond the edge of an excavation, and to place a stiff board or pole under the ends of rafters to distribute the weight evenly over a larger area (see Fig. 52).

(vii) **Horizontal Timbers.**—Horizontal timbers intended to receive direct support from posts should rest on the *top* of them, and not be fastened to their sides unless iron bolts of proper strength are available. The ends of such timbers should be arranged to meet immediately over a post. If the top of the post is too small, a "bolster" must be inserted below the joint (see top of post in Fig. 49).

(viii) **General Arrangements.**—Arrangements should be made (*a*) for additional rifles to fire *over the top* of the overhead

cover from behind the trench in case of emergency, and (*b*) in important cases a reserve parapet or fighting

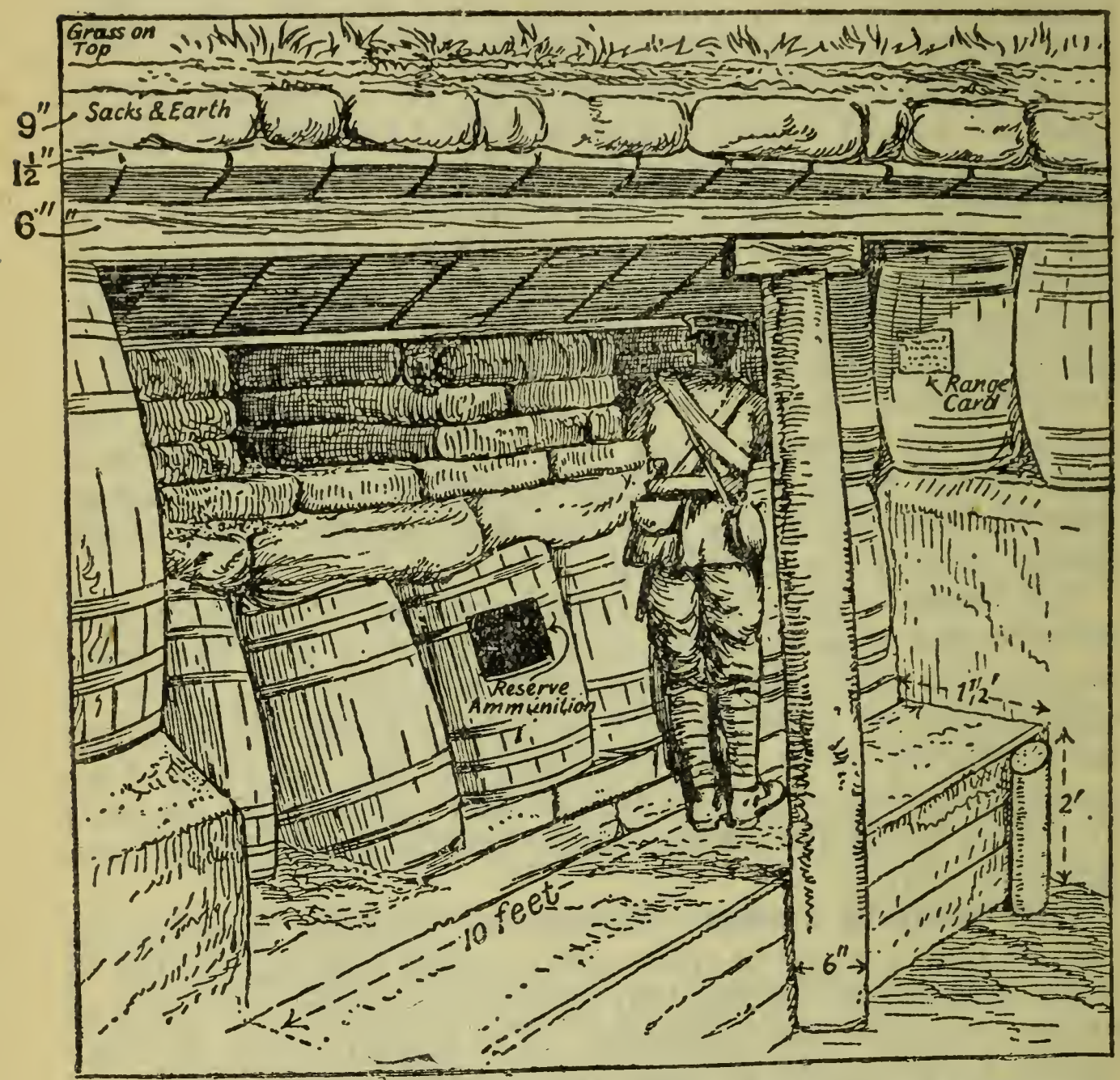


Fig. 49.—Overhead Cover for Two Men in the Firing-Line.

parados should be prepared behind a trench provided with overhead cover, so that firing may continue in spite of the

collapse of the overhead cover from shell fire, etc. (see Fig. 51).

(ix) It is an advantage if overhead cover can be made weatherproof.

4. Strength of Materials.—The following rough data on the strength of materials suitable for supporting earth in overhead cover may be useful as a guide :

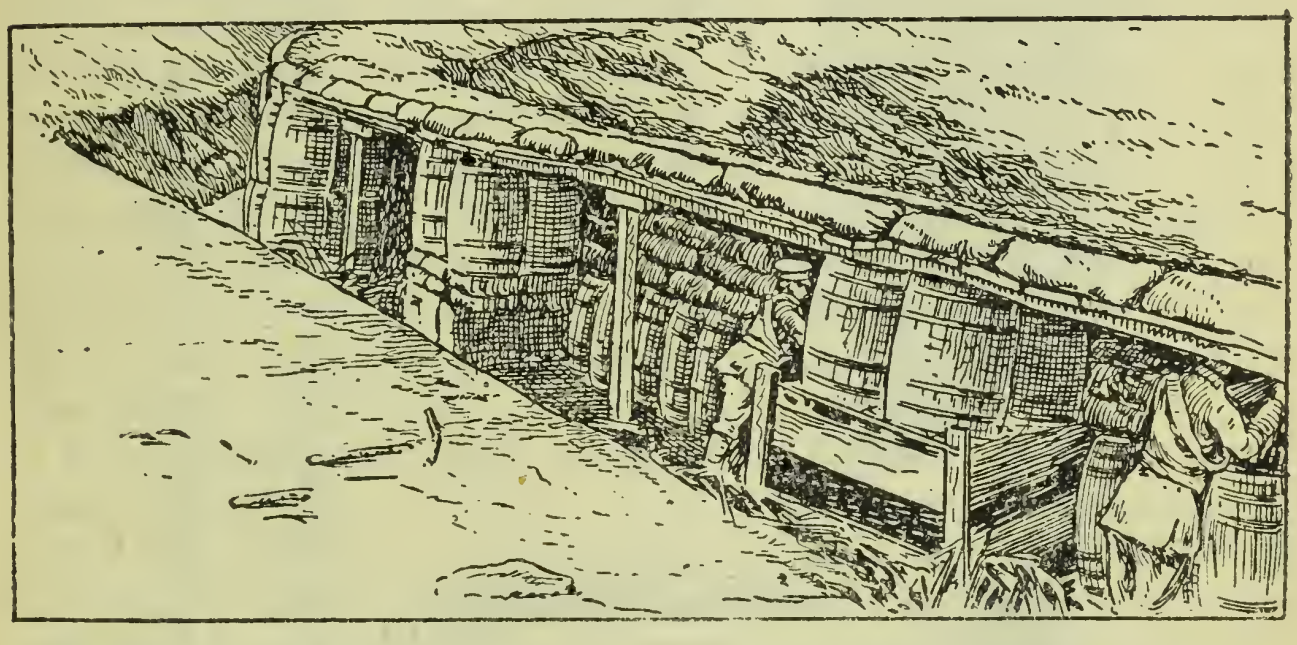


Fig. 50.—Overhead Cover in a Traversed Fire-Trench.

The front line of bags is purposely made distinct to show method of construction. In practice this line will be obliterated with earth and grass for concealment. Note the use of barrels in traverses and revetments.

(i) A round fir spar, apparently sound, 6 inches in diameter and not more than 8 feet high out of the ground, should carry up to 2 tons resting on the top without danger of breaking or distortion, or a load of, say, 40 square feet of earth 1 foot thick.

(ii) The same size of spar used horizontally as a rafter, 8 feet long, with supports under its ends, should safely

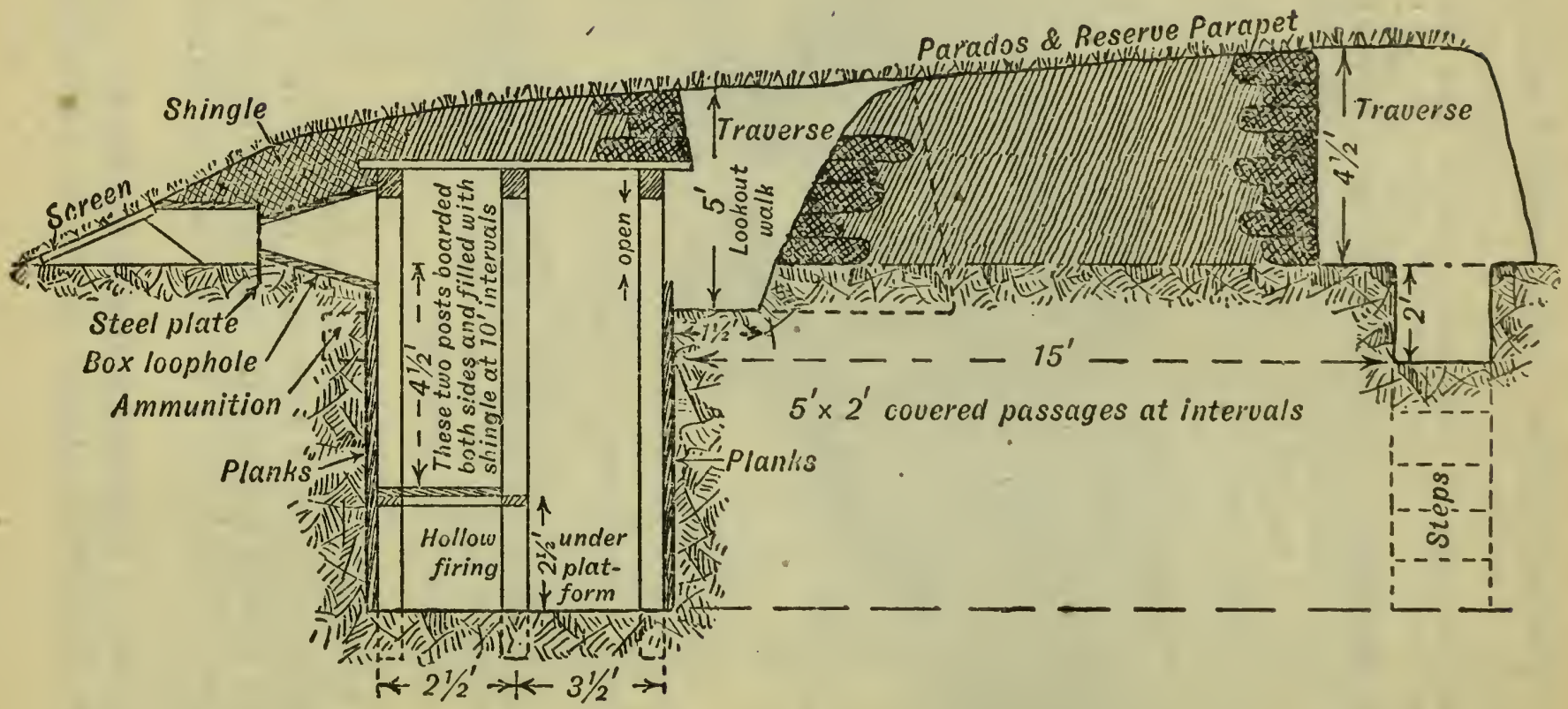


Fig. 51.—Deep Fire-Trench with Overhead Cover, and Reserve Parapet for Use when Overhead Cover is broken.

(See Figs. 67 and 68 for the appearance of this when viewed from in front.)

carry a load of 20 square feet of earth evenly distributed 1 foot thick. Such spars could therefore lie 2½ feet apart if the roof were evenly loaded with 1 foot of earth and the end supports were 8 feet apart.

(iii) Fir planks 1½ inches thick should safely carry earth 1 foot thick over gaps up to 4 feet wide.

5. Types of Overhead Cover.—Types of overhead cover are indicated in Figs. 49, 50, and 51. A reference to Figs. 34 and 44 shows that a recessed parapet is convenient for the support of overhead cover. Good overhead cover could be given to these recesses with doors, shutters, or table tops, from adjacent buildings, without the use of any special supports or tools, after the head-cover had been raised to the required height. Overhead cover for men who are *taking cover only*, and are not engaged in firing, is dealt with in the next chapter. An illustration of a simple form has been given in Fig. 26.

6. Bullet-Proof Floors.—A bullet-proof floor is sometimes required in isolated posts, such as blockhouses or defended buildings. As a rule this can only be arranged by the use of either a layer of shingle 6 inches thick or with steel plates ½ to ¾ inch thick, the range from which fire will be delivered being necessarily very close. In the case of the shingle it would be advisable to shore up the floor from below with additional supports to meet the heavy extra load.

7. Machine Guns.—The detachments should design and construct their own pits in each new site according to the nature of the fire required. A shelter (see Chapter V.) is required for each detachment, and it should be very near the gun, so that no time may be lost in opening fire. A protected lookout (Fig. 72) is also required.

CHAPTER V

SHELTERS AND COVER-TRENCHES

Protection when not Firing.

Section 10.—General Remarks.

1. Need for Shelters and Cover-Trenches.—The forms of cover dealt with in Chapters II., III., and IV. have all been of such a nature as to provide protection for men who are actively engaged in firing or observing and awaiting an opportunity to fire at the enemy. It has also been mentioned that under certain circumstances, such as lack of facilities for concealment and want of materials, or of time and labour, it might not be possible or advisable to arrange for overhead cover protection for the rifleman, while firing, without reducing the efficiency of his fire. The necessity for his protection against the plunging fire of artillery and long-range rifle-fire remains nevertheless a matter of such urgency, in a position deliberately entrenched for resistance, that steps must be taken at all costs to provide such cover as may be possible.

2. Tactical Considerations.—The well-trained soldier rightly imbued with the spirit of offence may question the tactical soundness of waiting under cover to be attacked when not in the presence of the enemy. But defensive tactics when *properly applied* may not only be sound, but also essential to victory. It must be remembered that a frontal attack upon a strong entrenched position held with determination cannot be carried out quickly in the face of modern firearms, and yet time may be an essential factor of

success for the enemy. Delay in the face of entrenchments may, therefore, adversely affect his plan of operations, and perhaps contribute to their failure.

Apart from the value of entrenchments for resistance, circumstances may occur in which attackers will have to get forward with the aid of trenches to the points from which their final assault can be delivered, and that while the struggle for local superiority of fire in such an attack is in progress the attackers will be compelled to use entrenchments to obtain this superiority. It must be remembered that it is by no means an easy task to overcome the resistance of well-trained troops fighting from under good cover in positions *where it is impossible to outflank them or to overwhelm them either by superiority of fire or by superior numbers under cover of darkness or through surprise*, and that under such circumstances the best chance of success may lie in using trenches first to get forward, and then to mass the assaulting troops within a short rush of important tactical points which must be carried. More elaborate forms of earthworks, therefore, may be necessary for offence as well as for active or passive defence.

Section 11.—Cover at the Firing-Points.

1. The following are examples of the circumstances in which the cover described in Sec. 10 may be required:

(i) Men on duty at the firing-points, not required to fire, as when undergoing a destructive artillery fire to which no response can be made with the rifle.

(ii) Men resting or awaiting intermittent opportunities to fire, such as machine-gun detachments.

(iii) Men on duty at firing-points only as supports or reinforcements to the firing-line, in self-supporting fire-trenches—namely, trenches the site of which, the importance of which, or their distance from ground suitable for shelter-

ing detached supports makes it imperative that the supports or reinforcements should be kept actually on duty in the fire-trenches themselves.

(iv) Commanders, fire unit commanders, observers, or lookout men.

(v) Signallers, orderlies, carriers of ammunition, supplies, etc.

(vi) Certain supplies and stores also may require cover at the firing-points, such as reserves of ammunition, machine and sometimes field guns, range-finding instruments, and any articles which would suffer damage or form an obstruction if left lying about in open trenches.

2. With reference to case (iii) above, the *Field Service Regulations* lay down that in defence "supports to the firing-line should be close to it, have covered communication with it, and be *under complete cover from shrapnel fire.* If this is not possible, the firing-line should be self-supporting."

3. Methods of providing Shelters.—Cover at the firing-points is usually provided by means of small and numerous shelters constructed wherever space can best be spared or chosen for them. In no case must the top of their roof covering show above the adjacent parapets or head-cover, or be distinguishable against their surroundings or background. They are usually formed—(i) by cutting recesses forward into the interior slopes of the existing fire-trenches, and re-covering the recesses to conform to the rest of the parapet; or (ii) by completely covering over short lengths of the fire-trench itself at points where its value for firing purposes is of least importance; or (iii) by an extension of any overhead fire-cover, already provided, until it completely covers in the whole width of fire-trench; or (iv) by roofing portions of communication or passage trenches which lead into the fire-trench, at points quite close to the fire-trench.

4. Roof Covering.—The nature of the roof covering for

shelters is, of course, dependent upon the materials obtainable, but no attempt is usually made to make it proof against unburst shells from artillery. Roof covering is only meant to be proof against shrapnel bullets and splinters from burst shells and hand-grenades, for which purpose, as mentioned above, any covering made from a few sheets of corrugated iron, or a few stout planks, a thickness of not less than 9 or 12 inches of earth or 3 inches of small stones or shingle, will be sufficient. The subject of making roof covering proof against artillery projectiles is dealt with in Sec. 16.

5. Rules for Construction.—The rules governing the construction of splinter- and bullet-proof shelters in the firing-line are therefore—

(i) **Nature of Shelters.** — *They must be simple, small, and sufficiently numerous to provide cover for each rifleman.* They should hold from one to five men each.

(ii) **Means of Access.**—*It must be possible to get in and out of them quickly.* They must therefore be quite close to the firing-points detailed for use by the riflemen they shelter, and must not have difficult or obstructed means of entrance and exit.

(iii) **Delivery of Fire.**—*They must not reduce the number of rifles which can be brought into action at any useful part of a fire-trench.* They must therefore either form no obstruction to the firing step and parapet of the fire-trench, or be placed at those points in the trench where the field of fire is of least, or of no, value.

(iv) **Exposed Openings.** — *The interior must not be exposed to direct fire from any direction.* The entrance must therefore be on the least exposed side, and further protected by a traverse, parados, etc., at a very short distance outside it. If the whole fire position is liable to attack from every side, *alternative* shelters opening in different directions must be provided.

(v) **Strength of Roof.**—*The materials of which the roof is formed must be strong enough to carry whatever weight is to be placed above them.* If under the parapet, there must be no danger of the parapet collapsing at a firing-point. The materials must be disposed in such a manner that local injuries or displacement will not involve unnecessary damage to adjacent parts of the structure.

(vi) **Partition.**—*At least three feet of solid earth should be left as a wall or partition between adjacent shelters.*

(vii) **Drainage.**—(*a*) *The roof should be water-tight if possible*, and (*b*) *the inside must be kept free from rain-water.* (*a*) may be arranged by introducing a layer of tarpaulin, canvas, straw, well-kneaded clay, reeds, iron sheeting, boards, etc., under the earth covering, and the earth itself may be well rammed as it is placed in position. (*b*) requires attention to the general drainage of the trenches and ground in the neighbourhood, as already mentioned. The roof should have a slight fall in the direction most suitable for disposing of water.

(viii) **Minimum Dimensions.**—*The allowance of sitting space.* The length should not be less than 1½ feet per rifleman. Width of seat from front to back, 1½ feet. Height of head room above the seat, 3¼ to 3½ feet. Depth of foot trench in front of seat, 1½ feet. Width of foot trench—Single row of men, 1½ feet. Two rows face to face, 3 feet and 4 feet when a central line of posts is used to support the roof.

(ix) **Shelters numbered.**—*Every shelter should be numbered at its entrance.* This may be done with chalk, paint, pencil, or knife-cut. The last is best for identification in the dark.

(x) **Provision for Rest.**—Shelters less than 6 feet wide, either length or breadth, will not permit a wounded man to lie down, or an exhausted man to rest or sleep, with any degree of comfort.

6. Shelter-Recess.—In fire-trenches made in favourable

ground—that is, ground firm and strong, but not too hard to excavate—individual riflemen can burrow forward into the interior slope at the level of the firing step, and ex-

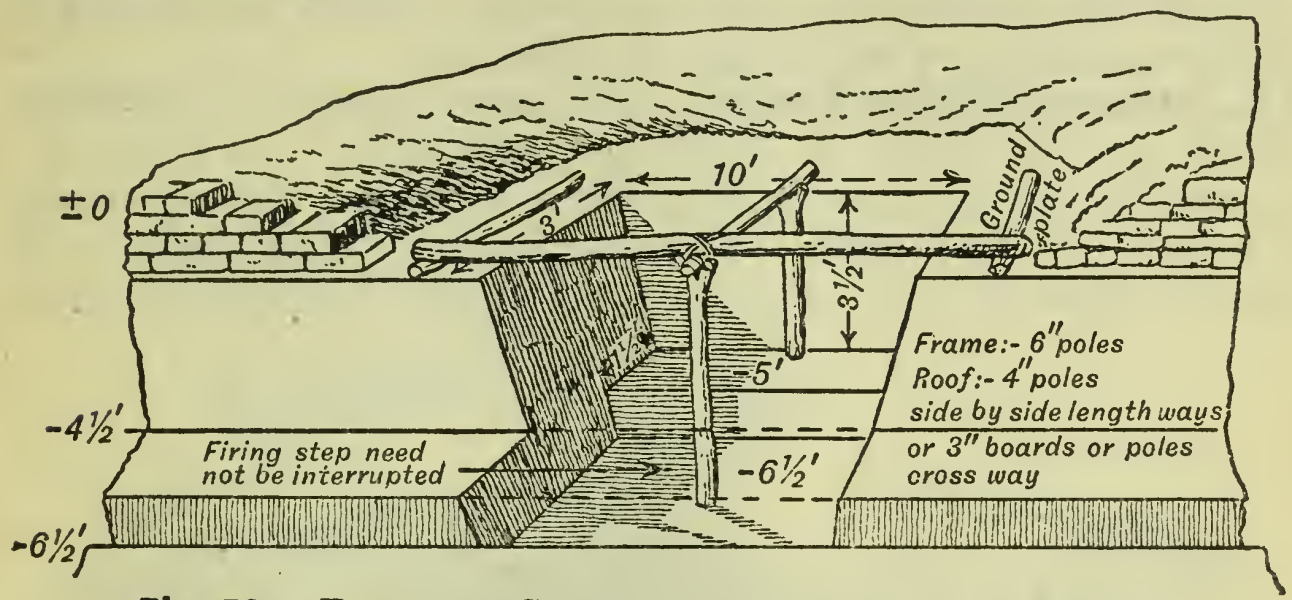


Fig. 52.—PARAPET SHELTER-RECESS: FRAMEWORK.

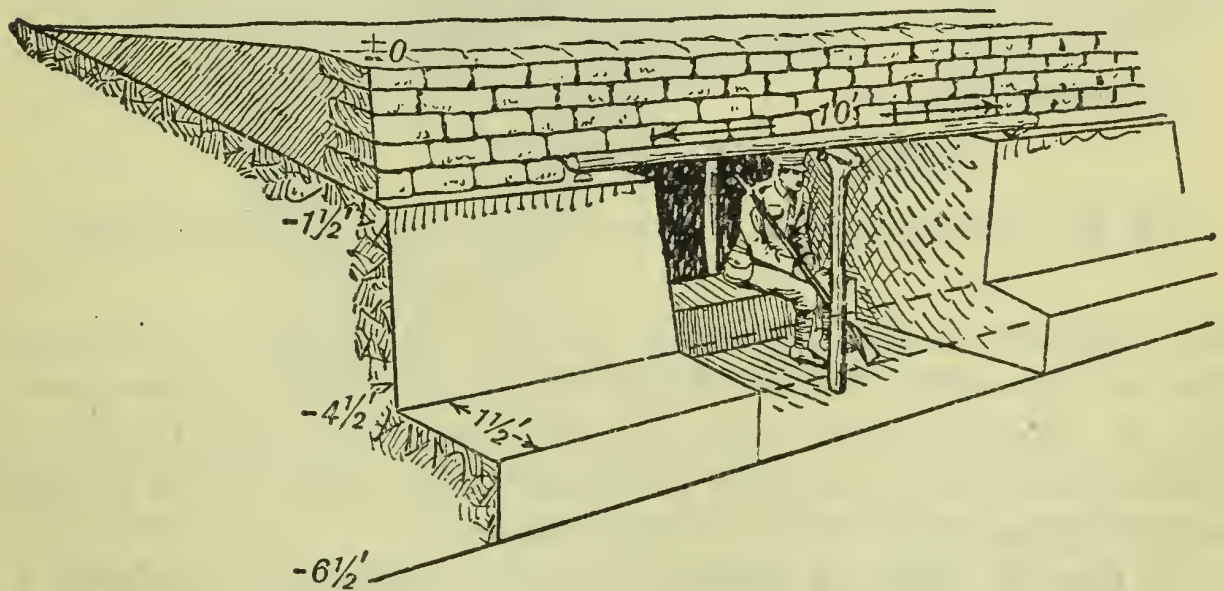


Fig. 53.—PARAPET SHELTER-RECESS ROOFED: ELEVATION.

cavate a shallow tunnel or burrow, about 2 feet in diameter by 5 or 6 feet long, in which they can lie in safety and at full length when not on duty at their firing-point,

and without the use of any roofing materials. If the earth cannot be trusted to hold itself up above such a burrowed shelter, the shelter can be formed as already described in Fig. 26 (single shelter under parapet), which illustrates a parapet shelter suitable for one rifleman.

7. Parapet Shelter-Recess.—(i) Larger parapet shelter-recesses can be made on the same principle. In Figs. 52, 53, and 54, an example is illustrated of such a shelter-recess suitable for five men. The method of construction is clearly shown in the figures. The points to note are that

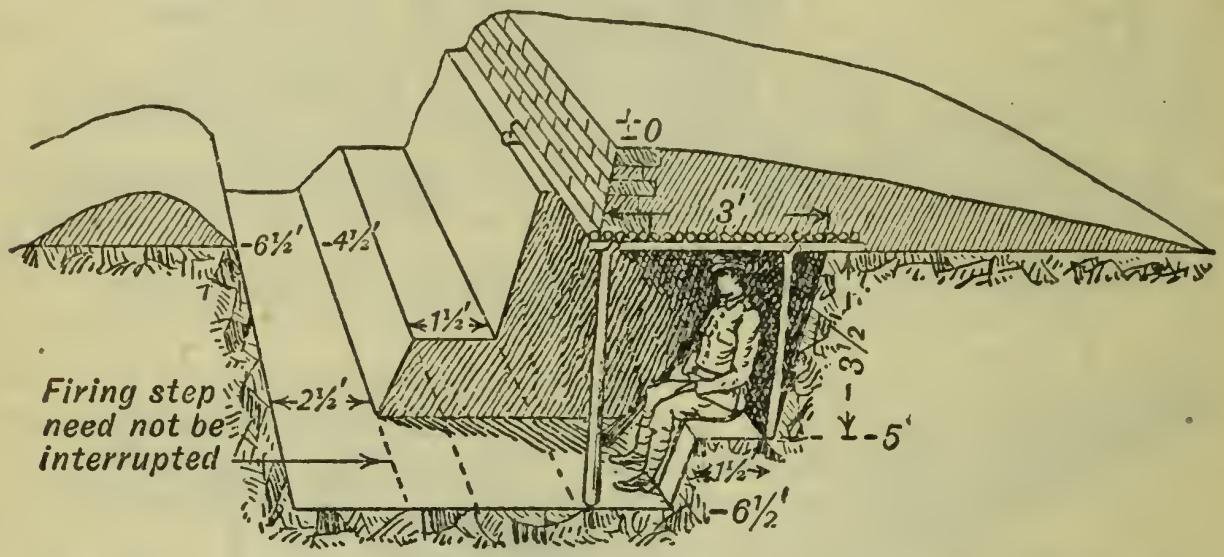


Fig. 54.—PARAPET SHELTER-RECESS ROOFED.—SECTION.

such shelter-recesses should be put in hand at the same time as the excavation of the remainder of the fire-trench, both in order to save a second removal of the earth already thrown out, and to avoid the temporary loss of fire parapet during the construction of the shelter.

(ii) **Use of Roof as Parapet.**—If the finished roof of the shelter-recess is required as a fire parapet, the firing step should not be cut down at the entrance to the shelter, but left as shown in dotted lines in Figs. 52, 53, and 54. The men can easily scramble in and out of the shelter through the opening which remains.

(iii) **Ground-Plates.**—The ground-plates shown in Fig. 52 are important, as without them the ends of the rafters may sink unevenly into the ground, and some will not do their share of supporting the weight above. The outside rafter also is liable to break down the weak top corners of the excavation unless supported as shown. The ground-plates

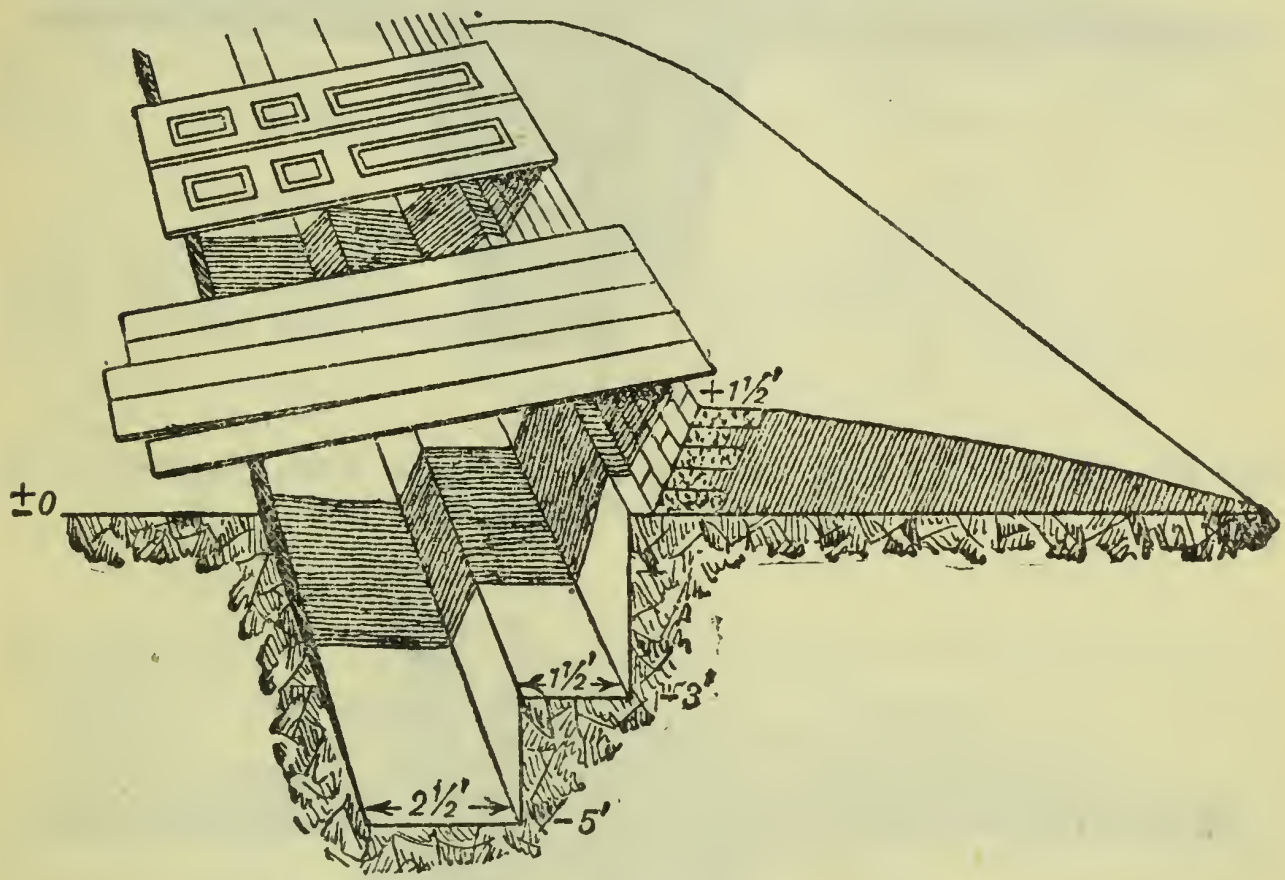


Fig. 55.—HASTY PARAPET SHELTER.

must be placed at a safe distance back from the edge of the excavation, say 1½ feet in doubtful soil, which would make the length of the rafters at least 13 to 14 feet for a recess measuring 10 feet long at ground-level, and require intermediate support.

(iv) **Transom.**—The transom, or central cross-piece, must also extend well over the back of the excavation, as shown in Fig. 52, for similar reasons.

8. Adding Overhead Cover to Parapet.—(i) When the provision of overhead cover has not been anticipated, and must

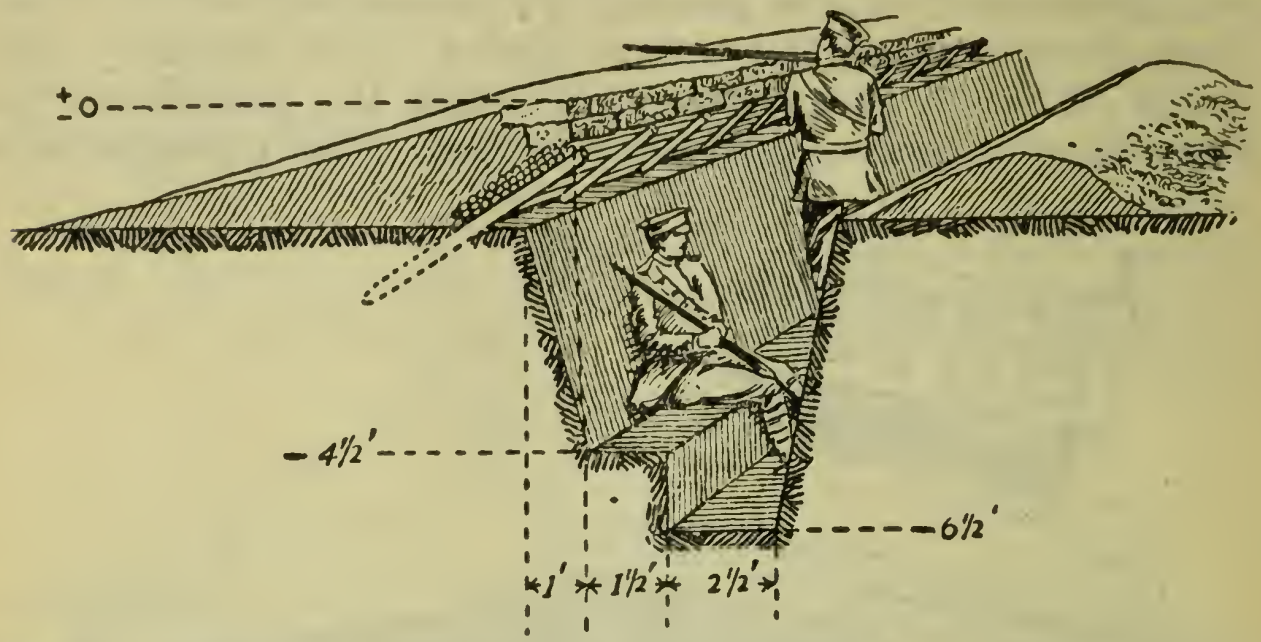


Fig. 56.—Parapet Shelter, with Pickets and Brushwood, One Foot Overhang.

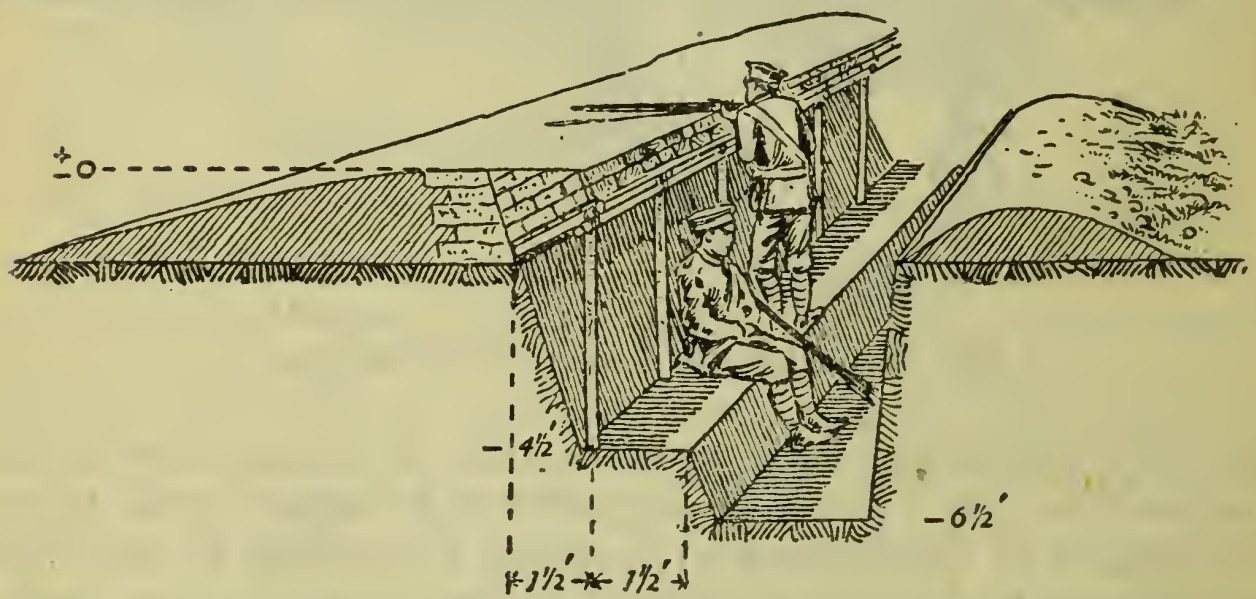


Fig. 57.—Parapet Shelter, with Pickets, Brushwood, and Supports, One and a Half Feet Overhang.

be added to a fire parapet already in use, the quickest way to proceed will usually be as indicated in Figs. 55, 56, and 57.

(ii) Fig. 55 illustrates doors, planks, or corrugated sheet-iron, etc., hastily laid across the trench, with a slight slope away from the enemy's chief line of fire. Such a shelter would often suffice to deflect shrapnel bullets, which have little power of penetration, but should be strengthened as soon as possible.

(iii) Fig. 56 illustrates the addition of overhead cover to a fire parapet by driving inclined pickets to support a slightly overhanging roof of earth on brushwood or planks.

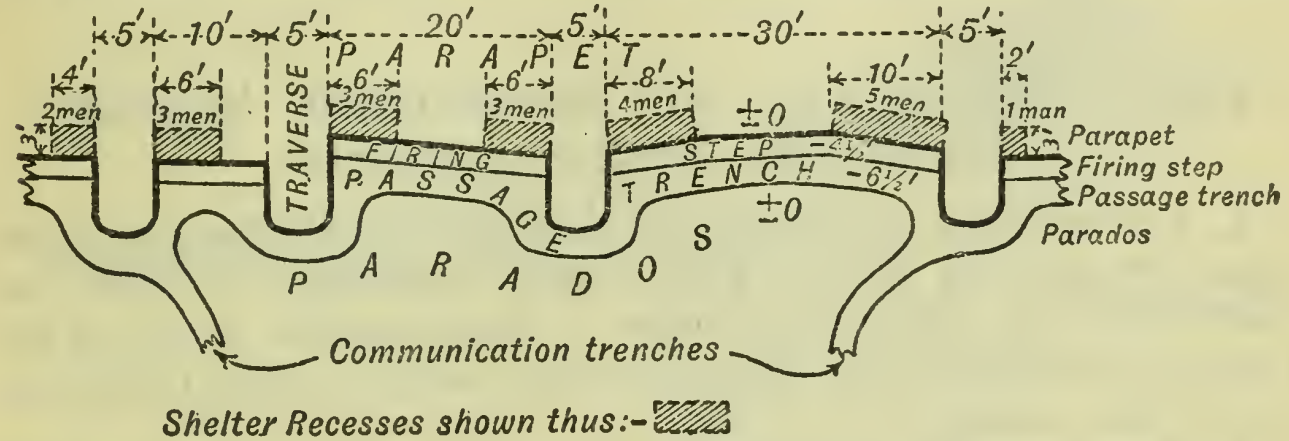


Fig. 58.—Examples of Parapet Shelter-Recesses: Plan.

(For typical details see Figs. 52, 53, and 54.)

(iv) Fig. 57 shows a stronger form of the same type of cover, in which a direct support from the foot of the interior slope is obtained by means of upright pickets. In arranging for such cover, it is necessary either to cut back the interior slope to a less steep angle or to allow for an extra width of firing step, if there is to be a passage trench in rear of the latter.

9. Traverses.—In the illustrations of overhead cover in fire-trenches, in order to simplify the illustrations, no traverses have been introduced into the pictures. In practical execution, however, the best sites for shelter-recesses are usually at the angles between the parapet and the traverses, as shown in Fig. 58. In this figure typical

examples are given of parapet shelter-recesses of sizes to hold from one to five men each, in a length of fire-trench with traverses from 10 to 30 feet apart. It must not be supposed that the varieties of size of shelter and of spacing between traverses shown in Fig. 58 would all occur in one such length of fire-trench; they are merely typical of the most usual range of treatment applicable to such fire-trenches in general, according to the local peculiarities of site, and the disposition and exposure of riflemen.

Section 12.—Cover for Ammunition, Supplies, Stores, etc., at Firing-Points.

1. Cover from splinters and weather should be provided also for articles which would suffer damage or form an obstruction if left lying about in fire-trenches, such as reserves of ammunition, hand-grenades, water, food, blankets, and other stores.

2. Ammunition Recesses.—Reference has been made to small recesses for spare cartridges. Such recesses can be formed in any way which will bring the cartridges to the hand of the rifleman without movement beyond reaching out his arm. A gap between sand-bags, or any small ledge or hole, will answer the purpose. It should usually be on the right-hand side of each rifleman. For reserves of small-arm ammunition, perhaps the best plan is to build the ammunition boxes themselves into the face of the interior slope of a fire-trench or into the sides and ends of traverses. The boxes should be built in *on edge*, with the wedged sliding lid *outwards* and ready to open by hitting the lid *downwards*.

In entrenchments fully equipped for deliberate resistance, an allowance of 1,000 cartridges per rifle would be a reasonable minimum to maintain. In a protracted defensive action or in repelling a determined assault, an

expenditure of six to ten rounds per minute would not exceed the requirements of aimed fire.

3. Hand-Grenade Recesses.—For hand-grenades recesses should be 2 feet deep from front to back, as the grenades are about 1 foot 10 inches long. A normal allowance of grenades to maintain in fire-trenches for use as a prelude to counter-attack with the bayonet may be taken as five grenades per rifleman. The recesses for them should be low down in

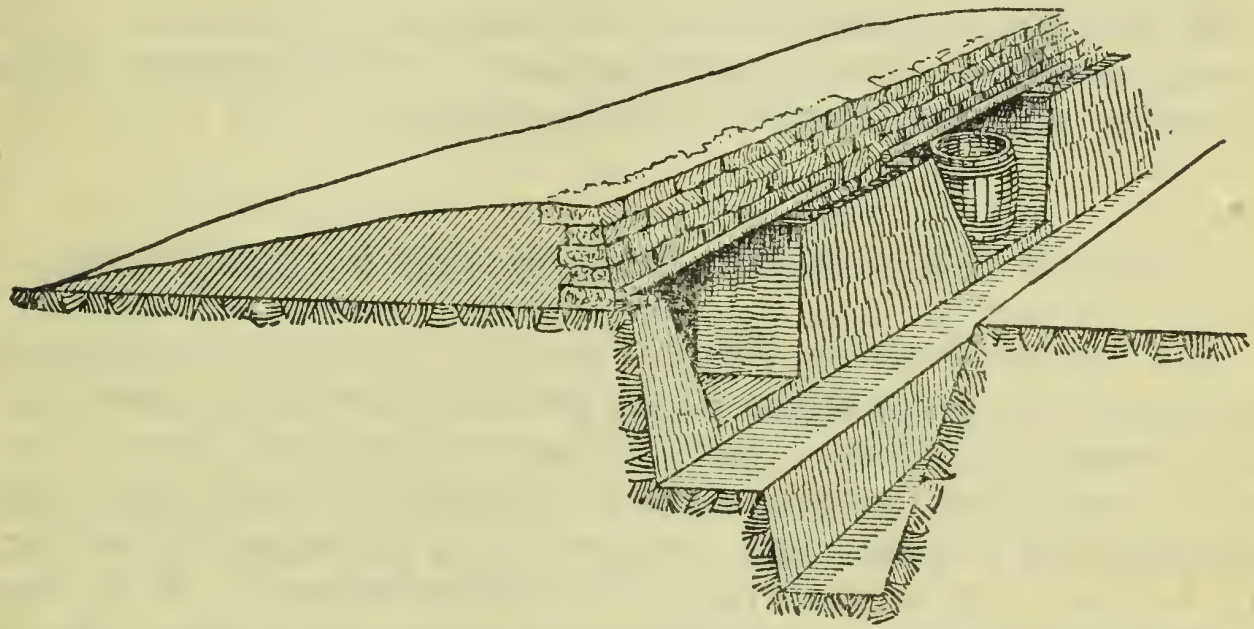


Fig. 59.—STORE RECESSES FOR WATER, HAND-GRENADES, RESERVE AMMUNITION, MACHINE GUNS, RANGE-FINDERS, BLANKETS, ETC.

the interior slopes of the trenches, in order to obtain good protection from shell-fire.

4. Drinking Water.—In self-contained or isolated fire-trenches it will be necessary to store a reserve of drinking water in the actual fire-trenches, but as a rule water would be stored in the cover-trenches behind the firing-points. It is a question for local decision whether it will be better to keep the reserve of water in one or two large receptacles in well-protected spots, or to store it in bottles, camp

kettles, or small receptacles, well distributed, as being safer. In any case the provision of a reserve of water is of vital importance, and must be considered carefully in constructing entrenchments. Half a gallon of pure boiled and filtered drinking water per day is the minimum reserve per man, and when cooking is possible the allowance should be at least one gallon per day.

5. Store Recesses.—The general nature of recesses suitable for stores is shown in Fig. 59.

6. Caution.—Care should be taken, in the use of the word *recess*, to distinguish between *firing* recesses, *shelter* recesses, and *ammunition* or *store* recesses.

Section 13.—Cover behind the Firing-Points.

1. The methods by which riflemen can be protected from shrapnel in entrenched firing-points have been considered in previous sections. Such firing-points, for a time at any rate, may often become isolated from any cover of a more substantial nature, and the troops in them must continue to remain self-supporting and self-contained. It is more desirable, however, when possible, to provide safe cover for supports or reinforcements close at hand, either quite out of reach of the enemy's fire, or in spots which will not be betrayed when fire is opened from the firing-points.

2. Tactical Considerations—(i) **Numbers.**—Not one more rifleman should be posted actually in the entrenched firing-points *at any stage of a fight* than will be justified by the results to be obtained from his fire when balanced against the probabilities of his becoming a casualty, or of his being of still greater value as a mobile fire-unit.

(ii) **Premature Occupation of Trenches.**—*Fire trenches must not be manned prematurely.* — It is laid down in F.S. Regs., that "until the attack is seen to be serious, it

will usually be advisable to form the firing-line of a few observers or skirmishers, the remainder of the troops allotted to the defence of the position being kept *under cover*." Even in the presence of an enemy to man fire-trenches whilst under artillery-fire at long ranges is only to risk heavy casualties besides increasing the probability of betraying the general disposition of the firing-points by careless exposure of men to view or premature firing.

3. Sanitary Considerations.—(i) On sanitary grounds men must not occupy earth shelters until the military situation actually demands it. They will be far better off, and will keep more healthy, in any shelter above ground, however frail. When the situation permits it, if even for an hour, the men should leave their shelters, come back out into the open, take exercise in fresh air, and wash themselves and their garments, while fatigue parties thoroughly clean up the fire trenches.

(ii) **Cooking, Latrines, etc.**—The above rule applies to cooking-places, latrines, and pits or fires for destroying refuse near the firing-points. These should be within *covered* reach of the firing-points whenever possible, but must only be used during emergency periods.

4. Covered Communications.—When men are kept out of fire-trenches till it is necessary to man them, good covered communications (Chapter VII. and Fig. 71) to them should be provided when possible. When it is not possible to provide such communications, it may only be possible to enter or leave the firing-points under cover of darkness, and instead of leaving a small picket and a few observers till the attack develops, it may be necessary to keep them fully manned, with the risk of the troops becoming temporarily isolated, together with various other disadvantages which have been considered in this section. On the other hand, the absence of safe means of communication to shelters in rear of the firing-points has been known to

induce troops to cling to such cover as they had at the firing-points which they might otherwise have abandoned inopportunely.

Section 14.—Shelter for Supports and Reserves.

1. It is usual to provide shelters somewhere close behind the firing-points, but in safer places when possible. For instance, if the firing-points were some way down a forward slope, the supports and shelters might be somewhere behind the crest of the ridge or hill on the reverse slope. Local reserves would usually be kept still farther back,

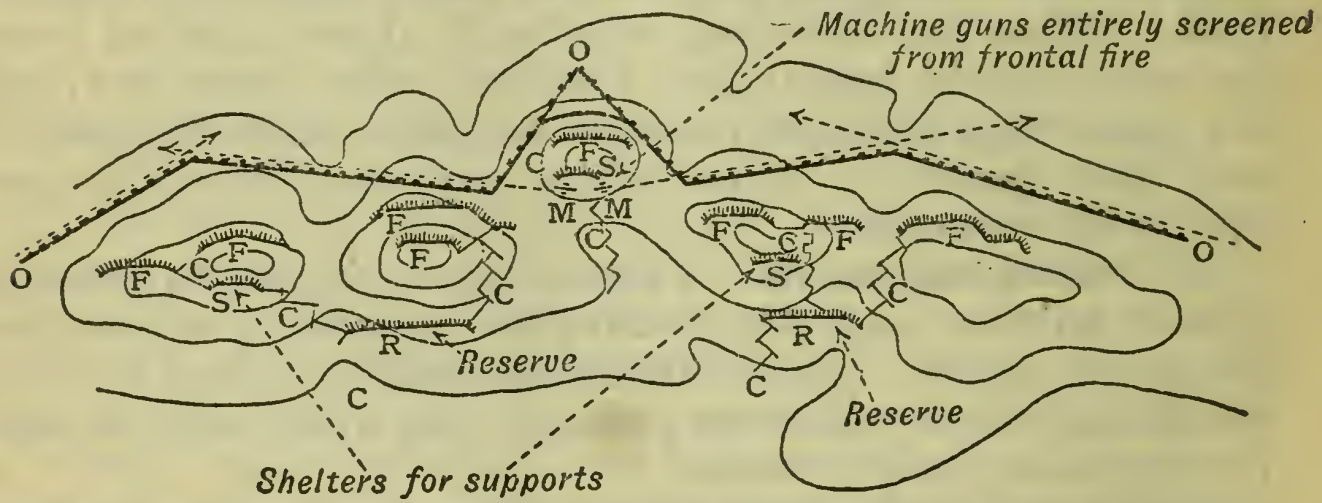


Fig. 60.—Example of Entrenched Firing-Line (*F*), Supports (*S*), and Local Reserves (*R*), with Communications (*C*), and Obstacles (*O*), flanked by Machine Guns (*M*).

and the question of safe cover for them must give way to the necessity that they should be posted with a view to rapid movement *in any direction*, and very seldom with a view to the direct reinforcement of the nearest fire-trenches. *If it is necessary to make artificial cover for reserves, it must be made clear that this is not a secondary position—namely, something for the troops in front to fall back upon—but that the cover is merely prepared to shelter the reserves until they are required.*

2. Example of Cover for Supports.—An illustration of entrenched firing-points and cover-trenches, or shelters, for supports and local reserves on an imaginary piece of ground is given in Fig. 60. The zigzag lines in the figure indicate the position of the communication trenches between the firing-line and the troops in rear. It may be mentioned here that these trenches are zigzagged in plan in order that no great length of any one of them may be swept from end to end by the intentional or accidental adoption of a particular line of fire on the part of the enemy.

3. Natural Cover.—Existing natural cover may sometimes suffice for supports, especially if there are steep-sided ravines, sunken roads, quarries, etc., available; but *if marked on maps* such places may be dangerous, as the enemy might at once suspect them of harbouring reserves of troops, and might concentrate a plunging artillery-fire upon them accordingly. As a rule the quickest method of forming shelters in such steep-sided hollows is to tunnel or burrow direct into the sides. From the fact that the exposed earth is already standing at a steep slope, it is a fair deduction that it will stand tunnelling into on a small scale without danger of collapse.

4. Buildings and Woods.—Excellent cover for supports can often be obtained behind substantial buildings which are not exposed to direct fire from artillery, such as behind two rows of houses in a street, or behind any substantial building which has many interior cross-walls, or under masonry road or railway arches which face in a favourable direction. Within a wood supports will be comparatively safe from direct shrapnel-fire if no longer able to see daylight when looking towards the edge of the wood nearest the enemy; but this rule might not ensure cover from rifle-fire or plunging fire from artillery, though neither of these would be very effective against an invisible target.

5. Artificial Cover.—When cover for supports in rear of

the firing-line must be provided artificially, the simplest form will consist of short lengths of cover-trench, as shown in Fig. 61. If pressed for time the trench should first be dug out about 3 feet wide by 3½ feet deep. It can afterwards be widened and deepened, as shown in Fig. 61, to provide an earth-seat for the men.

Splinter-Proof Roof.—If materials can be obtained, the cover-trench should be roofed in with a splinter-proof roof

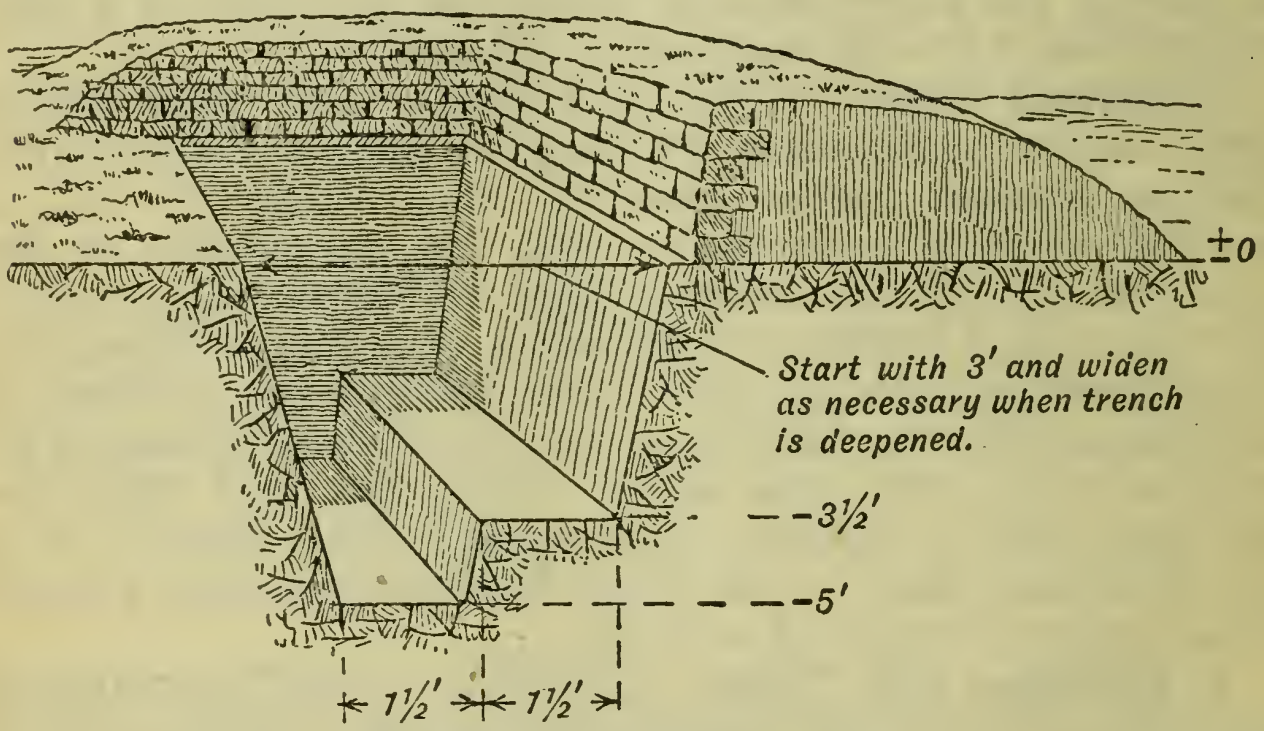


Fig. 61.—COVER-TRENCH.

as in Fig. 62. It is also a great advantage if this roof can be made water-tight by the insertion of a layer of straw, thatch, or well-kneaded clay, in the absence of iron sheeting, boards, canvas, etc., and by giving the roof enough slope for the water to drain off. The seat and floor of the trench will also be greatly improved by spreading a layer of dry grass, heather, etc., on them.

6. Construction of Shelter.—(i) The rules already given for shelters in the firing-line apply equally to shelters for

supports, and should be studied carefully. It may, however, be necessary to modify these rules when providing cover for supports in *well-sheltered sites* in the following particulars.

(ii) **Dimensions**—The size of the shelters may be increased if the site is very safe, and shelters to hold ten or even twenty men may be constructed. The most usual form for such a shelter would be as in Fig. 62, but of double

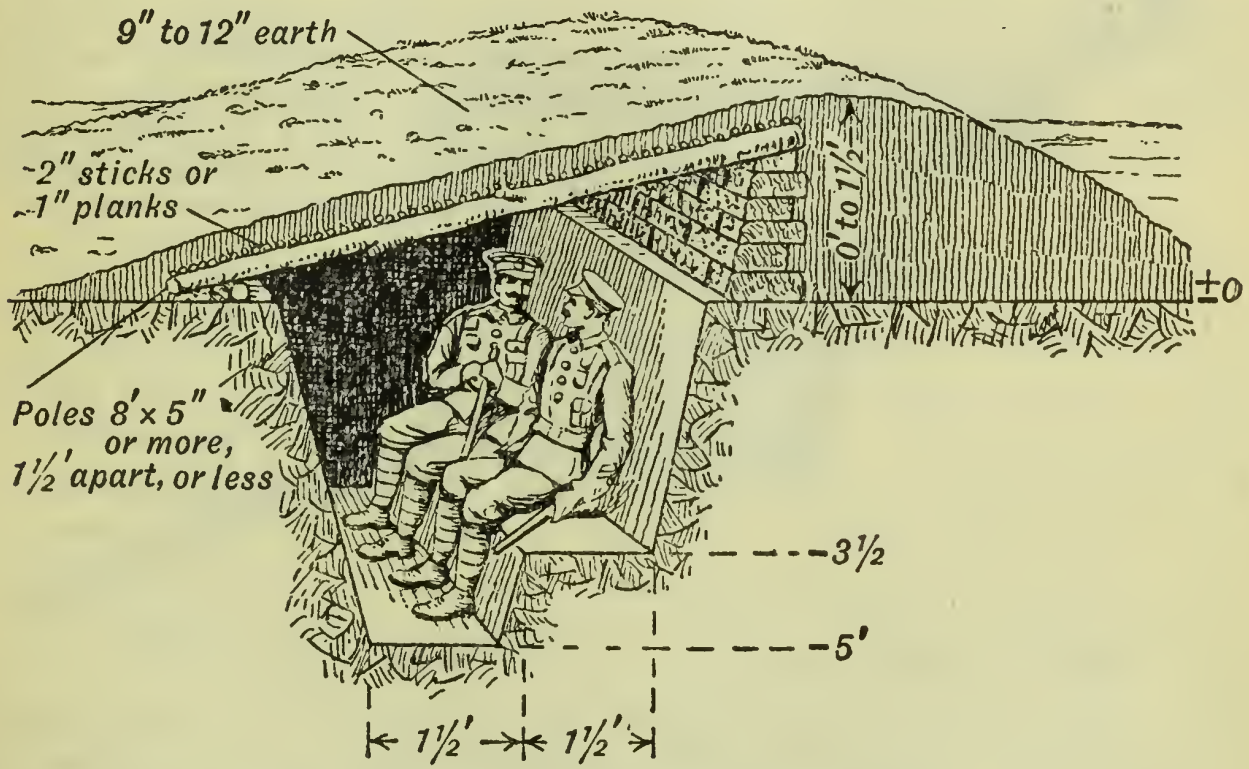


Fig. 62.—COVER-TRENCH ROOFED.

width—namely, for two rows of men sitting face to face, the width of the foot-trench being increased to 3 feet, or, better, to 4 feet if a central line of posts is used to support the roof.

(iii) **Provision for Rest.**—When plenty of time and labour are available, every effort should be made to provide shelters which will enable the men to lie down at full length for rest and sleep. This will require a bottom width of

at least 6½ to 7 feet if (*a*) the men lie *across* the shelter, or 5 feet if (*b*) they lie in two rows *along the sides* with a gangway down the middle. The latter arrangement is the more economical of roofing material, but requires slightly more floor space in plan. On the other hand, with type (*b*) the sides sufficiently raised above the central gangway serve

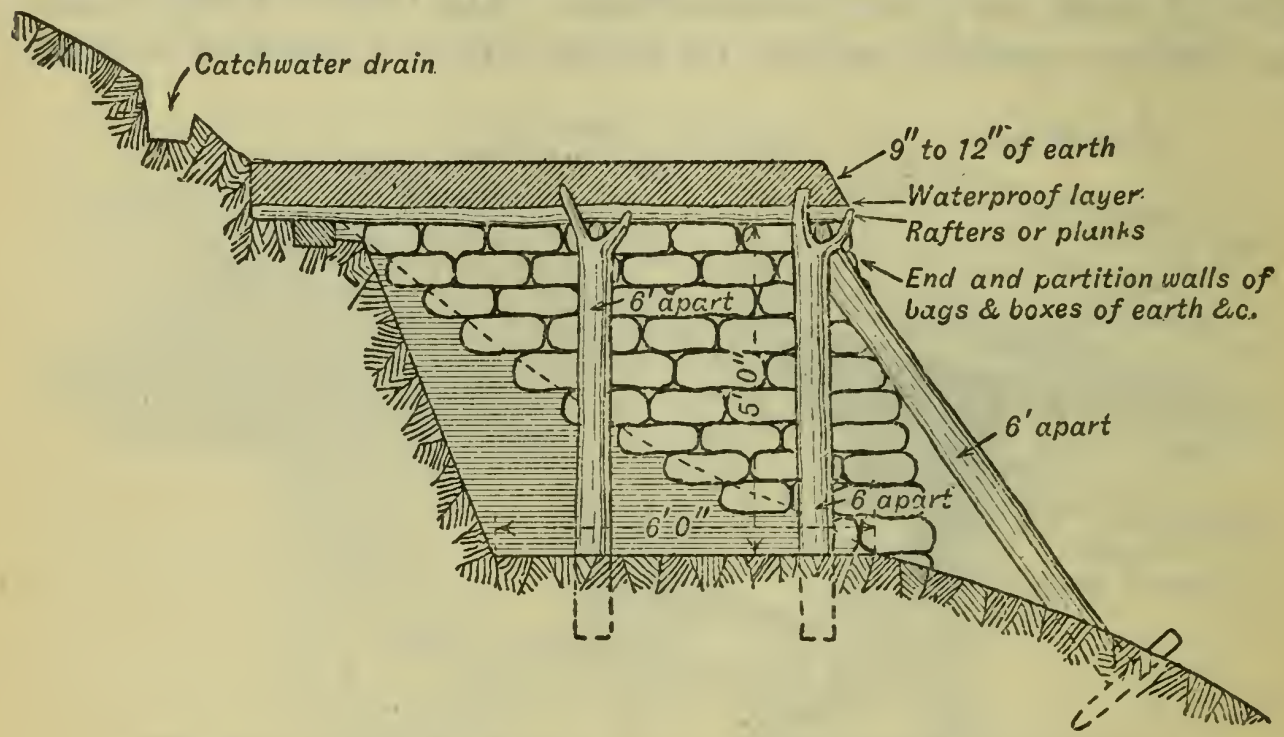


Fig. 63.—SHELTER FOR SUPPORTS ON A HILLSIDE.

Note.—The timbers used cannot be too strong, and, if arranged as shown, should not be smaller than 6 to 8 inches in diameter. The roof and floor should have a slight fall towards the lower ground. The open side may also be walled up breast high with bullet-proof material, leaving a small entrance.

as seats as well as beds, and thus provide comfortable alternative sitting accommodation.

(iv) **Hillsides.**—Sometimes, as on a hillside, it is not essential to sink a cover trench or shelter entirely below ground. One side may be open, and the earth wall replaced by one or more rows of stout posts, with stout timbers

resting on their tops to support one end of the rafters or planking of the roof (see Fig. 63). The outer row of posts must be well strutted, as shown.

(v) In planning all shelters of the type above described, it is convenient, when possible, to arrange the *length* in multiples of 6 feet clear measurement at floor or seat level, so as to ensure that all the men told off to the shelter can lie down. *All shelters should be small, in order to minimize losses from unlucky hits by shell and to localize damage.* No single length of shelter should exceed 12 feet measured from end to end between intermediate partitions (3 feet or more thick), if the shelters are arranged in a continuous row.

Section 15.—Dressing Stations.

1. The first shelter of any kind which is provided in rear of the firing-points must be chosen or made with a view to affording first-aid to the wounded. It is not always necessary to dig special shelters or cover-trenches for this purpose. If the facilities for removing wounded men from the firing-points are reasonably good, it may often be possible to send casualties straight away to the nearest habitable building which is not unduly exposed to fire, and as a rule any building with a roof on it is preferable to a hole in the ground, from the surgeon's point of view, as a first-aid station. Care must be taken to make the roof of these special shelters proof against rain.

2. **Construction of Shelters for Wounded.**—When circumstances compel the construction of excavated shelters for wounded, the method of construction differs in no respect from that of shelters already described; but special requirements will be necessary, and provision when possible should be made for the following, which, of course, may be supplemented. Figs. 64 and 65 illustrate such shelters without showing minor accessories.

(i) A plank table, 6½ feet by 2½ feet, and not more than 3 feet 3 inches high.

(ii) At least 2 feet clear walking space all round the table, and 6 feet of headroom.

(iii) A shelf 4½ feet above the floor-level, on which to place instruments, dressings, etc.

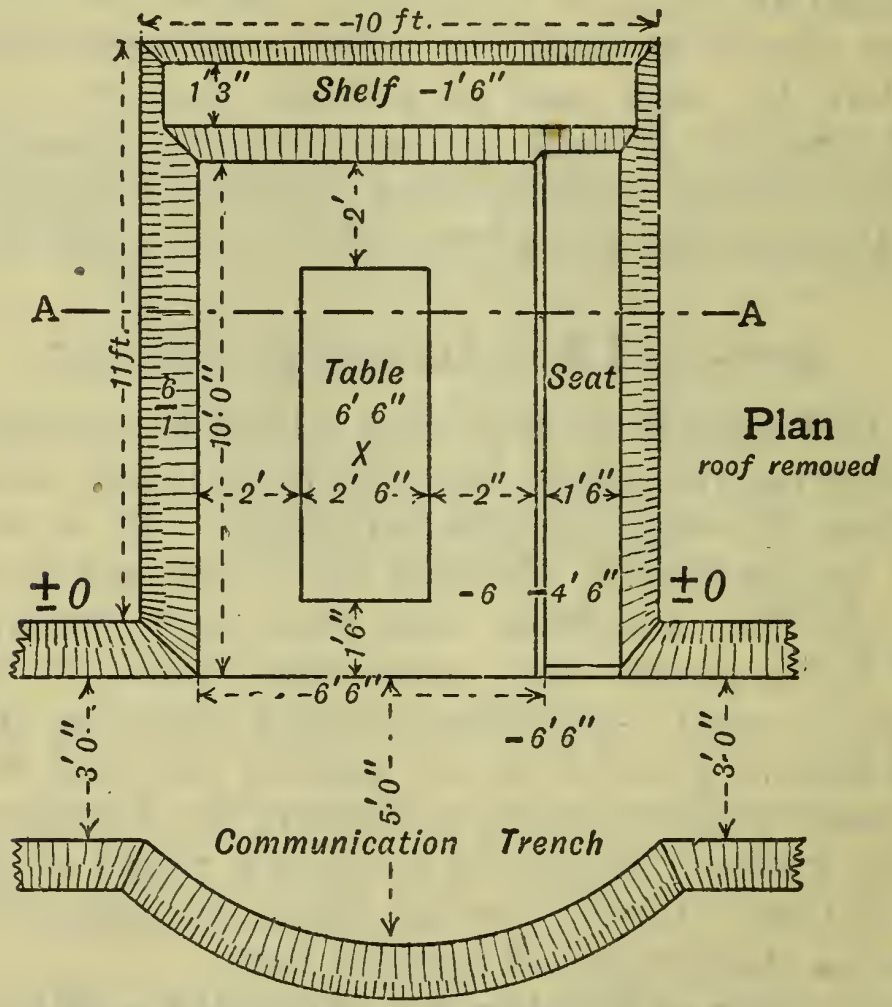


Fig. 64.—SHELTER DRESSING-STATION.

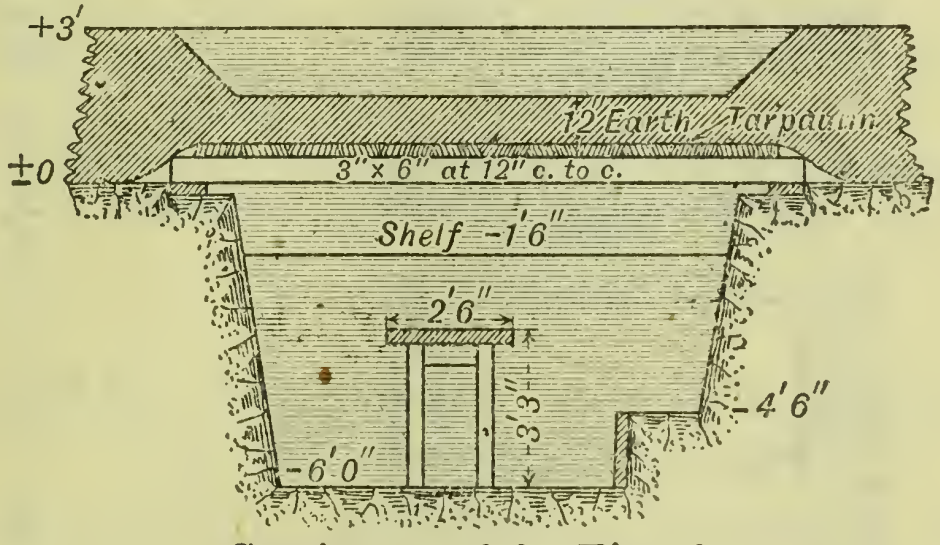
(iv) A seat along one or two sides of the shelter, 1½ feet high by 1½ feet wide for cases awaiting treatment.

(v) A covered receptacle with a draw-off tap for boiled water.

(vi) Means of suspending a light at night, and as much daylight as possible by day.

(vii) Plank lining to walls, ceiling, floor, seat, and shelf if possible; failing this, plenty of service waterproof ground sheets.

(viii) Another shelter close by, and in covered communication, to serve as a waiting-room for wounded.



Section on AA, Fig. 64.

Fig. 65.—SHELTER DRESSING-STATION EXCAVATED IN REAR OF FIRING-LINE.

(ix) A fireplace outside, however rough, on which a kettle can be boiled and small refuse burnt.

(x) A slop and refuse-pit within throwing distance of the entrance to the shelter. Loose earth and means of scraping it into the pit.

Section 16.—Shelter Roofing proof against Artillery Projectiles.

1. Before concluding the subject of shelters it may be useful to mention the actual thicknesses of roof material found necessary to afford protection against the impact of artillery projectiles themselves, and not only to exclude splinters and fragments of shell which burst elsewhere, which have already been dealt with in para. 3 (iii), p. 88.

Fig. 66.—Prepared Timbers suitable for Field Shelters (see p. 117).

2. **Field-Gun Shells.**—Against single shells from ordinary modern field guns, of about 3 inches calibre, 4 feet of earth, with a top layer of heavy stones or boulders to cause an early burst, gives fair protection unless the angle of descent of the shell is very steep.

3. **Howitzer Shells.**—Against field-howitzer shells not larger than 6 inches calibre 7 feet of earth on 12-inch logs side by side gives good protection. Against howitzers larger than 6-inch thickness up to 16 or 20 feet of earth or 10 feet of cement concrete reinforced with steel may be necessary.

Section 17.—Government Store Materials suitable for Splinter-Proof Shelters.

1. The subject of splinter-proof shelters is considered in this book with the object of training the rifleman to make such shelters with any material which may be available under the conditions of warfare in the field. It may, however, be useful to state that materials suitable for lining shelters are kept as articles of Government store in case they may be available. In considering these materials it is of course impossible to provide for every contingency with regard to sites on level or hilly ground; but the timbers illustrated in Fig. 66 would form suitable shelters with the minimum of trouble in most cases, and can be put together or taken apart without skilled assistance. All that is necessary is to dig the hole to the required depth and size, place the groundsills, stanchions, and topsills in position, and then bury it under any thickness of earth up to 7 or 8 feet if desired. The timbers illustrated are articles of Government store, and their official description is "*Cases Great Gallery*," each "case" including the set of four pieces—two sides, bottom, and top.

CHAPTER VI

CONCEALMENT

Section 18.—General Remarks.

1. Need for Concealment.—Cover from both the view and the fire of the enemy will lose much of its value as soon as the enemy becomes aware of its exact nature and position, and the disposition of the troops occupying it. Consequently one of the cardinal principles for the strengthening of fire positions lays down that *the enemy should be deceived as to the strength and dispositions of the defending troops, and the character of their works.*

2. Meaning of Concealment.—The word "concealment" as applied to the military art of deception means concealment of *intention.* For example, a fire parapet planted with turnips still remains *visible,* though the enemy may imagine it to be a natural excrescence in a turnip field instead of what it actually is. The total concealment of fortifications in its strict sense may be impossible now owing to reconnaissance by aircraft. Concealment, therefore, is for practical purposes a form of deception.

3. Methods of Deception.—There are two forms of deception open to the rifleman, which may be described as *simulation* and *dissimulation.* The former may be described as pretending that things are what they are not, and the latter as pretending that things are not what they are.

4. Objects of Deception—(i) **Power of Offence.**—The main object of deception is not only to decrease the enemy's power of offence, *but to increase the defender's power of*

offence. It must therefore be remembered that deception is merely a means to an end—namely, *to secure victory through the power of offence.* Deception is carried out by riflemen in connection with an entrenched position with the following objects :

(*a*) To provide good targets on which the enemy may easily direct and *waste* their fire without harming the defenders.

(*b*) To provide bad and indistinct targets at every point where the defenders might suffer damage from well-directed fire.

(ii) It is, of course, only when entrenchment is more or less deliberately carried out, and not made in the presence of the enemy, that thorough measures of concealment can be undertaken on a large scale, though much can be done to render targets indistinct and misleading, even when the work is done in the presence of the enemy.

5. General Principles of Concealment.—(i) The fundamental principle of concealment is that the whole existence and site of a zone of resistance must first be masked or concealed; then it may be strengthened by the use of the spade; then the works may be concealed in detail.

The value of concealment cannot be over-estimated, and every effort must be made to conceal the site of all earthworks in a position. It should always be borne in mind that invisibility is often as valuable as cover itself, while one carelessly constructed trench may give the enemy a good idea of the whole position.

(ii) Such portions of the position as are liable to detection through distant examination by the enemy should receive earlier and more careful attention than those parts which will not be seen until he has drawn closer. All earthworks, whether completed or not, must be concealed as far as possible, and all tools, materials, and signs of work in progress removed or concealed on each occasion that

work proceeding in the presence, or possible presence, of the enemy is suspended for a longer period than for a routine relief of the working parties. Every artifice should be used to mislead the enemy as to the positions of the real trenches and guns. For example, conspicuous dummy parapets may be thrown up to draw his fire, and may also be equipped with dummy guns, paper masks, helmets, etc.

(iii) Concealment of all kinds takes a long time to carry out. It is important, therefore, to *reduce the visible area of parapets*, etc., which are to be concealed, and no superfluous earth should be added after bullet-proof cover has been attained. It can be thrown out behind as parados or sent away. In collecting materials for concealment, men must on no account be permitted to strip turf, dump earth, or remove natural vegetation, except in the exact spots permitted by the leader of the party, who will, of course, see that the resulting scars will not tend to betray the works as a whole.

(iv) The work of any general scheme of concealment should be carried out under the supervision of one person, who will be made responsible for the scheme as a whole, and who will, if possible, direct the work from a distant point in the direction of the enemy, which permits him to see as much as possible of the frontage being concealed. No success will as a rule follow the disjointed efforts of individual men to conceal particular points, and care must be taken to guard against the general tendency of men to plant daisies where cabbages are required, or, in other words, to forget that they must aim at effects which will be seen in the mass from long distances. The tendency to work too much for an effect from side to side along a fortification which still leaves a parapet with the appearance of being a long artificial *line*, and to ignore work on the foreground and background of the fortification, with the object of breaking up this linear effect, must also be guarded against.

(v) In case it may be thought that too much stress is being laid upon the concealment of positions, it must be remembered that all students of war are now agreed that it is more essential to preserve a work from view than to protect it from fire, since no known form of field fortification is proof against artillery fire. It is true, as already stated, that it may be impossible to conceal field fortifications from aircraft, but it will nevertheless be difficult for artillerymen to recognize targets consisting of really skilfully concealed positions, from the description of air-scouts, who view them from above.

Section 19.—Simulation.

1. Object of Simulation.—The object of simulation—namely, the erection of dummy works—is to produce targets more attractive to the enemy than those the defender does not wish them to select, and at the same time to influence the enemy's dispositions by a threat of danger. Such works are specially useful to assist in carrying out deception on a big scale, as in an advanced position or screen to a main position. *Care must be taken that dummy works are not so placed that fire directed at them will take effect against the defenders elsewhere.*

2. Dummy Parapets are formed by scraping up the least amount of earth which will give the appearance of a fire parapet from the enemy's probable artillery positions. They may be from 1 to 3 feet high, and should be arranged in short lengths, and in general appearance like a carefully-planned chain or group of proper fire-trenches. The earth of the parapet need have no thickness at the top—that is to say, its cross-section may be a triangle.

3. Dummy Garrison.—A few caps or helmets or more elaborate "heads" waving to and fro on springy twig bodies, and some of the enemy's captured rifles or machine

guns damaged beyond repair, may be suitably disposed behind these parapets. Savages sometimes employ their dead for this purpose.

4. Dummy Trenches are formed by making a shallow cut about 3 to 5 feet wide along the surface of the ground, deeper at the back than in front, the edges to cast sufficient shadow to conceal their lack of further depth. They may often be formed by merely stripping the turf off the ground. The garrison may be provided as described in para. 3 above.

5. Dummy Guns can be formed from a telegraph-pole or gate-post, etc., mounted on the forecarriage of a farm-waggon, with a board shield. The general outline should be convincing, and requires a little trouble. Partial concealment may cover up any marked deficiencies in appearance. A couple of ounces of powder touched off from time to time on a tin shelf at the muzzle has been known to draw hundreds of pounds' worth of carefully-fused live shell. If this is fired electrically at the same moment as a good gun well concealed elsewhere, the value of the dummy is increased.

6. Dummy Obstacles can be made by driving stakes into the ground as though for a wire entanglement, without adding any wire; men passing through this dummy in view of the enemy should crawl on the ground and step over imaginary wires.

7. Concealment of Dummy Works.—It is open to question to what extent any attempt at concealing dummy works, or making them truly indistinguishable from real works, is likely to be an advantage to the defender. There is no doubt, however, that once the lie of a position has been accurately gauged by the enemy, as evidenced by his choice of targets, concealment has lost its value. The only assistance to be obtained from further artifice is to multiply attractive targets to the fullest extent, and so induce waste and dispersion of the enemy's fire. *When it is desired to conceal the existence of a whole position, dummy works must not be made at all.*

Section 20.—Dissimulation, or Screening.

1. Object of Dissimulation.—The object of dissimulation is to produce targets less attractive to the enemy than those which would be offered by the undisguised works of the defender, and which are less likely to arouse the enemy's suspicions, while at the same time they conceal the true nature of the defenders' powers of offence. In the same way that an advanced position may deceive the enemy as regards a real position to which it forms a screen, the defender may seek on a smaller scale to screen various single objects from the enemy's observers, as, for instance, a parapet, a fire-trench, a man, a field-gun, the flash of discharge of a gun, an obstacle, a party of men at work.

2. Methods of Dissimulation.—The methods at the disposal of the defender for reducing or masking the enemy's facilities for distinct observation of any particular object consist of the judicious use of one or more of the following natural phenomena:

(*a*) Direct interception of view by an opaque substance.
(*b*) Form and outline.
(*c*) Colour and light.

3. Direct Interception of View.—(i) This occurs naturally during darkness, fog, dust-storms, etc. It can be produced artificially by (i) raising a screen in front of the object; (ii) sinking the object below the enemy's line of sight; (iii) by producing artificial darkness.

(ii) **Screens.** — Artificially-raised screens are suitable for hiding guns and waggons, or the flash of discharge of a gun at night, for hiding a path or road which is to be used for communication, for hiding riflemen provided they can see to fire through the screen, and for hiding any other object

which would be more distinctive or attractive as a target than the screen itself.

Such screens would usually be made from local growths of vegetation, shrubs, brushwood, grass, etc., though a screen made of canvas or similar material would be better than nothing for the purpose of concealing traffic along a visible communication track. Natural screens, such as scrub, heather, long grass, etc., close in front of firing-points, should never be trampled down or otherwise interfered with more than is absolutely necessary to give a clear field of fire. The greatest care should be taken to prevent men cutting up the ground near a fire-trench by needless traffic, or dealing with loose soil so that it spoils good vegetation which is required for concealment.

(iii) **Sinking the Object below the Line of Sight.**—This process hardly requires explanation, as it forms the basis of most of the spadework already described in this book. In its simplest and most practical form, as applied to fire-trenches, it consists in dispensing with a raised parapet altogether, or, if this cannot be done, in keeping the parapet as low as is consistent with a good field of fire over the foreground.

(iv) **Artificial Darkness.**—This can only be a temporary expedient. It was formerly produced by the discharge of black powder. It can be produced by burning damp straw or setting fire to vegetation to form a heavy cloud of smoke. The darkness of night may be intensified by throwing the beam of a searchlight across and some way in front of an object which it is desired to screen.

4. Masking by Form and Outline.—(i) It is seldom possible to obtain reliable concealment by direct interception of view in the case of earthworks, as the effect of a separate screen is often as inconvenient to the defender as to the attacker. The only reliable principle to follow in all attempts to conceal earthworks is to get them to

CONCEALMENT OF OVERHEAD COVER.

Fig. 67.—Front view of **Fig. 51.** Loopholes closed.
Fig. 68.—Front view of **Fig. 51:** Four loopholes in use. Screens down. (Loopholes marked X in the figure.)

To face p. 124

blend in form and outline with their surroundings in such a manner that, even if distinguishable as features of the landscape, they are not distinguishable as entrenchments.

(ii) **Example of Screened Fire-Trench.**—An example of concealment applied to a fire-trench with overhead cover similar to Fig. 51 is given in Figs. 67 and 68. The overhead cover rises some 4½ feet above the general level of the grass meadow, but, although the photographs are taken at a range of 10 yards only, this fact is not apparent until the face of the soldier is seen at the top in the middle of Fig. 68, so well does the cover blend with the background. At a range of 200 yards the whole of the head-cover appears only as a slight roughness on the surface of the meadow. There are four loopholes in each photograph, and in Fig. 68 four riflemen are actually firing through them. In Fig. 67 light grass screens, raised and lowered from inside the work, are in the raised position; while in Fig. 68 the screens are down, as can be detected at this close range by the four black holes. The parapet and overhead cover come to an end immediately beyond the right-hand loophole, as seen in the photograph; but no straight or sudden edge has been allowed to appear. The cover merges imperceptibly into the hillside. This work of concealment required about one and a half hours' labour per man, after completion of the earthwork, including the making of the light screens for the loopholes.

(iii) **Avoidance of Skyline.**—It is perhaps easier to suggest what should be avoided than to attempt to lay down what should be done with regard to the skyline. The crest or outline of a work must not show up against the sky when viewed from the positions most likely to be taken up by the enemy's artillery observers. The term skyline is relative, and a work which is below the skyline viewed from a distance of three miles may be against the skyline when viewed from the foot of the hill on which it is assumed for the moment to be sited.

(iv) **Straight Lines and Sharp Angles.**—Straight lines and sharp angles are not usual in Nature, and nothing betrays a fire-trench more quickly and surely than to give the parapet a regular crest outline and steep ends against an irregular background. It is essential for troops to be trained *not to leave earth they throw up into a parapet so regular in outline that it forms a straight line against its background when viewed from a distance.*

As a rule it is difficult to avoid a straight line without the help of portable objects taken from surrounding ground, such as bushes, boulders, or large tufts of undergrowth, which must be arranged so as to make the artificial features harmonize with the natural. On bare ground the parapet and its crest-line must be blended with its surroundings by harmonious irregularity, for if deception is too uniform it may defeat its object. A general mistake made in attempting to conceal earthworks is to concentrate all transplanted objects, vegetation, etc., on the parapet itself. A better effect is often obtained by placing them on the foreground just in front of the parapet, etc., so that they conceal a larger patch.

Common examples of methods of harmonizing earthworks with their surroundings are the imitation of the ridge and furrow effect in a ploughed field, replanting with turnips, etc., in a root-field, and with thick grass turf in a meadow. No ingenuity will conceal a raised parapet on smooth, short-mown grass. However carefully the turf is relaid and tended, it will show up as long as the grass remains smooth and short. The difference in colour and shadow caused by a change of slope and form can never be overcome on any very smooth surface.

(v) **Colour of Subsoil.**—In many soils the earth changes colour below the surface, and it becomes important to save the original top layer by throwing it to one side with a view to replacement. This is especially important in the case of

chalk underlying a shallow layer of turf and earth. Sandy and gravelly soil often becomes darker below ground, while black or dark vegetable soil becomes lighter. In each case the original top layer should be saved and replaced. In the case of trenches cut on a steep hillside, great care is required to conceal the back edge of the cutting, which will often be clearly visible above the front edge as seen from a distance.

(vi) **Litter, etc.**—It is little use attempting to hide fresh earth by a vague litter of plucked grass, broken branches, etc., which will wither and die in a few hours, and so increase the suspiciously artificial appearance of the earthwork. With a woodland background, however, a good deal can often be done with dead leaves, sticks, etc., if judiciously littered well over the foreground as well as over the new earth. In the neighbourhood of farms and villages, also, a general litter of straw, hay, ashes, cinders, and old rubbish, can be used to disguise fresh earthworks. In high standing corn, after reaping sufficient foreground, the stubble should be carefully replaced over fresh earth parapets, etc.

(vii) **Ends of Parapets, etc.**—The ends of raised parapets or banks require particular care. However skilfully the front appearance may have been disguised, if the parapet comes to a sudden stop with steep ends the fortifications may be obvious to the enemy. It is therefore important to form all ends so that, viewed from the front or slightly from one side at a distance, they appear to merge imperceptibly into their surroundings. A wide ditch or trench is extremely difficult to conceal. Much may be done with house carpets, stack-covers, tarpaulins, etc., spread down and littered over with local material, and by keeping the surface width as narrow as possible.

(viii) **Contour Level of Ground.**—Where concealment is being sought, it is almost imperative to trace a fire-trench in plan so that it follows a natural contour level of the ground, a

point which is often of importance also in avoiding enfilade fire. If it is required to change the level higher or lower for fire purposes, separate lengths of trench must be made, and any communication trench between the different levels must be completely roofed over and concealed.

(ix) **Disguising Objects.** — Another class of masking by form and outline consists in disguising particular single objects other than earthworks. This is commonly done by artillerymen, who disguise their guns, and specially the sharp-angled gun-shields, and wheels, with bushes to give them the general appearance of a clump of vegetation in harmony with their surroundings. Raised observing-stations also, such as ladders, require the assistance of some local feature to conceal them, such as a dummy tree or stack.

(x) **Faces.**—The hardest features to blend with Nature are perhaps the relatively light-coloured faces of troops. The value of careful concealment of the body by khaki clothing is discounted by the appearance of numbers of distinct whitish moving discs. Concealment, when necessary, may be carried out by arranging grass or leaves on the cap or helmet. There is scope here for local head-dressing to suit environment.

5. Colour and Light.—(i) These factors must be studied in any attempt at good concealment. Far too much value is usually attached to colour in elementary attempts at rendering objects inconspicuous, forgetting the law *that any object which is not self-luminous will only appear to be of the same colour so long as it is illuminated by the same light.*

(ii) *Outline of form, roughness of surface, and similarity of substance, are of far greater importance to the rifleman who wishes to blend objects with their surroundings than the passing effects of colour and light.* It is true that by painting the underside of a big gun a lighter colour than the

remainder, in imitation of the colouring of many wild animals, the distinctness of its form can to a certain extent be reduced. But no use of paint, either in spots or stripes, will ever destroy the smoothness of surface and sharpness of outline which proclaim it for what it is to the military observer.

(iii) Attempts at concealing other smooth surfaces, such as cement concrete paving, by the use of colour alone have long been found totally ineffectual. Colour, however, has great value in spite of these limitations, and khaki uniforms, sea-grey ships, and field-guns painted a greenish brown, all have their moments of almost complete invisibility, which would not be obtained if they were painted a brilliant white or were permitted to shine like polished steel. This invisibility, however, is only momentary, whereas similarity of form and texture with the environment will often provide invisibility in spite of marked difference of colouring.

(iv) In the field the rifleman has but few opportunities of changing the colour of any object he wishes to conceal; he can only guard against betrayal due to neglect of the action of light upon various surfaces. He can avoid the black shadows cast by loophole openings in head-cover by the use of the light screens, laid at the same slope as the outer surface of the head-cover, which have already been described. He can avoid steep slopes to earthworks facing the enemy, which also mean dark shadows and visibility. He can arrange to cast new shadows upon smooth artificial surfaces and straight outlines, and so break them up. He can avoid leaving a different-coloured earth exposed to view in regular strips and patches, and he can use mud-wash to splash upon conspicuous new objects, such as wire-fencing posts and steel loophole plates.

(v) Every article served out from army stores for use by the rifleman in fighting should as a matter of course b

issued already treated so as to reduce its visibility. For instance, bayonets should be browned or oxidized, metal equipment dulled, and barbed wire painted green or brown.

Section 21.—General Rules for masking Earth-works.

1. Interfere as little as possible with the natural aspect of the locality.
2. Avoid artificial outlines which can be seen against the sky or background from the enemy's probable observing points.
3. Keep all earth parapets low, or dispense with them. Save enough top soil to spread over earth which changes colour.
4. On forward slopes open to the view of the enemy keep the width of trenches and ditches narrow, and obscure the back edges from view.
5. Cover over from view, with at least a light screen in tone with surroundings, all passage trenches, including those which pass round the back of traverses, in fire-trenches.
6. Lower the back edges of traverses at the top so that they do not stand out against their background.
7. Round off, roughen, and blend with surroundings, all straight lines and steep slopes, especially the crest line and ends of parapets.
8. Remove marked peculiarities on the ground which might provide good aiming-points for the enemy, such as a white rock, a single tree, a signpost, an advertisement hoarding, a bare patch of different colour to that of the surroundings.
9. Do not allow sentries, workmen, etc., to wear footpaths, wheel tracks with barrows, etc., in conspicuous places, or to damage undergrowth of value for concealment.
10. When grass is short, turf must be stripped at least 4 inches thick, saved, and replaced with the utmost care, and large cracks must not be left between adjacent strips. Additional turf must not be cut where the scars may betray the works. The turf which will come at the foot of a new parapet

should not be cut out, but raised and rolled back in readiness to unroll above the new earth without showing the join. If this has not been done, special care must be taken that the edge thickness of the lowest layer of turf on the parapet is not visible.

11. When there is ample time and need for elaborate and very careful concealment, the work may include the sowing of local vegetation seed. This should always be done when it is possible to obtain any quick-growing seed. Trenches may still be useful subsequently to the situation in connection with which they are constructed.

12. The larger bushes, etc., of those transplanted for concealment purposes should be used well in front of and low down on the parapet, etc.

13. All loopholes through head-cover must be plugged or blinded with easily removable plugs or screens, so placed that (i) no daylight can be seen through the hole, and (ii) no black shadow remains visible from the front.

14. Let one person control the work of concealment from as far to the front as possible. The eye of the artilleryman is well trained for this purpose.

15. If a certain path or track in full view of the enemy must be used, a quite obvious canvas screen is better than nothing, for the enemy will hardly waste ammunition in firing continually at this screen on the mere chance that it may be in use at any given moment.

16. DO NOT SPOIL OR REDUCE ANY PORTION OF YOUR OWN FIELD OF FIRE IN THE EFFORTS FOR CONCEALMENT.

CHAPTER VII

COMMUNICATIONS

Section 22.—General Purposes of Communications.

1. In this chapter it is only proposed to deal with such improvements of the ground for the movement of foot traffic as might have to be undertaken by the rifleman, more especially in connection with attack and defence operations as distinguished from communications for general movement across country, which are usually undertaken by the engineers. Before dealing with their construction, the general purposes for which military communications are usually required may be considered. These are—

(i) To enable the infantry to reach the enemy in superior force with the bayonet at a decisive time and place. *This is the supreme tactical object of all communications.*

(ii) To enable further supports, reinforcements, ammunition, and food, to reach the foremost attackers, and, conversely, to facilitate the removal of the wounded and non-effective to make room for fresh troops.

(iii) To enable leaders and messengers, ammunition and supplies, to pass safely along the front of attack from one firing-point to another, or men to be transferred, gathered, or dispersed, between the various firing-points, according to the distribution most suitable to the ever-varying tactical requirements of a fight.

(iv) To enable any portion of the firing-line to be withdrawn unseen at times when their fire has no value or is required elsewhere, or to enable troops to be withdrawn locally from an unfavourable fight in order to conform to a change of general plans.

(v) To enable troops who are not engaged with the enemy, or who are of non-combatant services, and materials of all kinds, to be moved safely and quickly from and to any desired point.

2. Communications in Attack and Defence.—The conditions which the communications mentioned in para. (i) to (iv) inclusive, must in each case fulfil as far as possible are—

(*a*) The track must be available for use night or day, and in all weathers.

(*b*) It should be concealed from the enemy's observation, and derive its safety chiefly from this concealment from view.

(*c*) It should provide for movement in both directions.

(*d*) It should be as short and direct as possible.

(*e*) It should not cross another track which is liable to be in use at the same time.

(*f*) It should be easily identified by night or day, and its destination must be unmistakable.

Section 23.—Communication in the Attack.

1. Artificial lines of approach for use in the attack can rarely be constructed beforehand, though they can be reconnoitred previously to an advance. The selection and use of *natural* ground cover for lines of approach is intimately associated with the use of ground for fire purposes. Features of the ground, such as undulations, hollow roads, embankments, ravines, hedges, ditches, belts of trees, walls, etc., which lie in a direction generally *parallel* to the

enemy's firing-lines may be used for fire-cover and lateral communications, while those which lie generally *directly towards* or *end on* to the enemy may be used for radial or forward communication for the attackers.

2. There are two factors which under existing conditions often make a direct advance by the use of cover afforded by ground features almost impossible. These are:

(i) The fact that the enemy have carefully posted themselves at firing-points the foreground of which is to a great extent naturally free from such ground cover, or has been so made by them.

(ii) The intensity and accuracy of the fire delivered by the enemy from behind cover, artificially provided and concealed, which may render it impossible for the best troops to attain the superiority of fire necessary to cover the launch of an assault with the bayonet.

3. Under such conditions the construction of communication tracks or approaches to the next position for an advancing firing-line may still become necessary before the assault can be delivered, despite the need for pressing forward to the attack at all costs without delaying it for the purpose of entrenching, which is the cardinal principle of offence.

4. **Constructing Forward Communications.**—One method of carrying out this work is to detail a certain number of men, calculated according to the distance, to attempt to establish a chain of communication as the attack proceeds. Their exact distribution will depend upon the nature of the ground, but they should each be provided with a full-sized entrenching-shovel and a grubber. They might be dropped in pairs at intervals of about 20 yards along the chosen track for communication, but only over such stretches of ground as do not already provide *cover from the view* of the enemy.

5. Each pair of men, as soon as posted, then will proceed

to dig themselves straight down into the ground, forming the narrowest trench that they can work in, say about 2 feet wide, *end on* towards the enemy as regards general direction, but *pointing clear* of one flank of the enemy's known firing-points. The two men, having each dug about 1 foot deep by 6 feet in length—which might take from half an hour to an hour under fire at intervals—then proceed to work *away* from each other, one forward and one back, to meet the corresponding man from the next pair with this shallow furrow, which will just cover a man crawling slowly along.

6. All the earth should be thrown out on the exposed side. The fact that it will not be bullet-proof is of minor importance so long as it hides a man while crawling along. Those lengths in which no casualty has occurred should meet in about four hours' work or less according to the spacing of the men and the hardness of the ground. Single workmen from a small reserve under cover at the starting-point or at suitable intermediate natural cover should be detailed to make a dash for each spot where a man is signalled as a casualty along the original chain.

7. If this chain of men only succeeds in establishing a chain of pits within shouting or throwing distance of each other, it will still be of the greatest value to the attack, and work must continue unceasingly at every opportunity until this chain of pits becomes a safe sunken path through such lengths as are exposed to view or fire.

8. By night it will often be possible to extend men throughout the whole length of such a path, and to work with full-sized entrenching-tools at the usual interval of about 5 feet from each other. With only the original chain of pits it will still be found in practice that the shooting of the enemy will not be so accurate as to prevent an active man, who chooses his own moment, from making a dash from pit to pit in comparative safety.

9. It must be remembered that men at work on all such communication trenches *must be protected by covering fire* from such an interruption as a local sortie or counter-attack by the enemy. These men will, of course, have their arms with them ready for use, but in addition to this it will greatly strengthen the attacker's general hold on the ground if short lengths of ordinary fire-trench are thrown out right and left of such a path at points favourable for bringing fire to bear upon any attempt by the enemy locally to outflank the actual front firing-line, and as a means of developing fresh covering fire at closer ranges to assist the general advance of the firing-line, or to cover its withdrawal if necessary.

Section 24.—Advance by Covered Approaches.

1. This method of advance was formerly the distinguishing principle of a regular siege upon permanent fortress works, but in recent campaigns it has been found necessary to make use of regular covered approaches against all kinds of field fortifications. A few notes on such of the principles of a systematic advance by covered approaches as should be known to every rifleman will now be given without entering into minute technical details. For fuller information, see *Military Engineering*, Part II.

2. (i) The following paragraphs roughly outline the sequence of events in turning an enemy out of any entrenched position by *active attack* with the spade, *excluding the possibility of his defeat by artillery bombardment only, or by outflanking or outmanœuvring his position, either locally or as a whole.*

(ii) A portion of the enemy's general line of resistance is selected, the capture of which will lead to *decisive results*—either to the immediate collapse of the rest of his defence, or to such a good foothold for the attackers that adjacent works

can gradually be forced with the leverage obtained from the ground or works already captured. There are other points to be considered in choosing the *point of attack*, as it is called, but this is by far the most important one, and the key of the enemy's position is almost invariably attacked unless its situation on the ground renders the attackers' own line of communication for supplies, etc., so liable to interruption, or so costly to maintain, that it outweighs the prospects of an early decisive result in the mind of the commander of the attacking forces.

(iii) Having selected the point of attack, the next step—and here the vitally important factor of arrangements for support by artillery fire must be taken into account—is to *select the particular work* of defence, or small group of works, the capture of which will probably lead to decisive *local* results as regards the capture of the point of attack, or at least to the capture of points from which a more decisive attack can be directed by signal communication as the result of better means of observation.

(iv) In this selected work, etc., is next selected *the actual spot* or spots which (*a*) it is possible to approach without undue delay or loss, and (*b*) the capture of which it is thought—by an entry in overwhelming force—will lead to the capture of the remainder of the work.

(v) The ground is then minutely studied to choose the best and quickest routes for pushing forward covered approach-trenches towards this spot. These approach-trenches, *which should be as numerous as possible*, are not dug right into the enemy's firing-line, for that would only bring the attackers up one at a time, and in such a way that the enemy could easily dispose of them. They are dug with a view to establishing a firing-line *parallel* to the enemy's firing-line opposite the spot selected as in para. (iii) above. This line must be near enough to throw hand

grenades* into the work, or to reach it by a short rush—that is to say, it should be less than 50 yards away. The line should be *long* enough, if possible, to produce a firing-line which will tend to envelop that of the local opposition, and *deep* and *wide* enough to hold a greatly superior number of men when the moment arrives to collect them there, and to launch the attack in such numbers that, in spite of losses, they will still overwhelm the local opposition.

(vi) The system is simple, but requires great skill and judgment in the selection of the right spots at which to force an entry; in arranging for overwhelming support from the artillery, and from the remainder of the attacking force, with a view to keeping the defenders pinned to their ground, and so fully occupied elsewhere that they cannot support the threatened spot in time to save it; and in arranging to withstand the enemy's supreme efforts at recapture which will follow hard upon the attackers' entry.

(vii) In order to maintain the secret of which spot is selected for assault, and to distract the enemy's attention and disperse his fire during the construction of the approaches, it will usually be *necessary to make for several works or groups at the same time*—certainly for those to right and left of the selected spot.

(viii) An approach cannot as a rule be run right up to the final position for assault in one operation. It requires constant support from covering fire, and at every favourable spot of ground, as it is reached, ordinary fire-trenches must be run out right or left, or both ways, to provide covering fire for the construction of the next length of approach, and to help those working on other approaches in the neighbourhood.

(ix) It is often possible to seize these favourable positions on ahead by a stealthy dash over the open at night.

* For directions regarding the use of hand grenades, see the *Musketry* Manual of this series.

The men, having entrenched themselves for firing, can then work *backwards* to meet those working forwards from behind, and so hasten the completion of the approach-trenches.

3. Best Point of Entry.—The best point of entry as a rule is the "blindest eye" of the work. That is to say, the particular spot in its firing-line where its own fire is least effective over its immediate foreground, or is least well supported by cross fire from adjacent works, or from artillery in the distance. Such a spot, as regards the shape or trace of the defenders' firing-line, is usually to be found where there is a more or less pronounced forward angle or salient. For example, if the work were square in plan, one of the corners would probably be the best point to make for, since the defenders' fire must be weaker over the foreground here than elsewhere. If the work shows no pronounced salient, the choice of the spot will probably be determined by the best line of approach.

4. Lines of Approach—(i) **Good Lines of Approach.**—The best line of approach is as a rule over the ground which is least overlooked by the defenders, and which is least under fire when quite close to the work. Examples of good lines of approach are—(*a*) Up the backbone of a spur of ground which runs forward from the work towards the attacker; this gives good positions to the attacker against sorties, and enables him to engage the adjacent works to keep down their fire, or to keep just out of the way of one of them by advancing under cover of the backbone of the spur; (*b*) up a deep and steep-sided ravine or watercourse, which leads in the required direction unseen, and is free from fire to within a short distance of the work.

(ii) **Bad Lines of Approach.**—Examples of bad lines of approach are—(*a*) Downhill towards the enemy; (*b*) along the bottom of an open valley, or up a "re-entering angle" exposed to the fire of two or more adjacent works; (*c*) straight across the defenders' strongest field of fire.

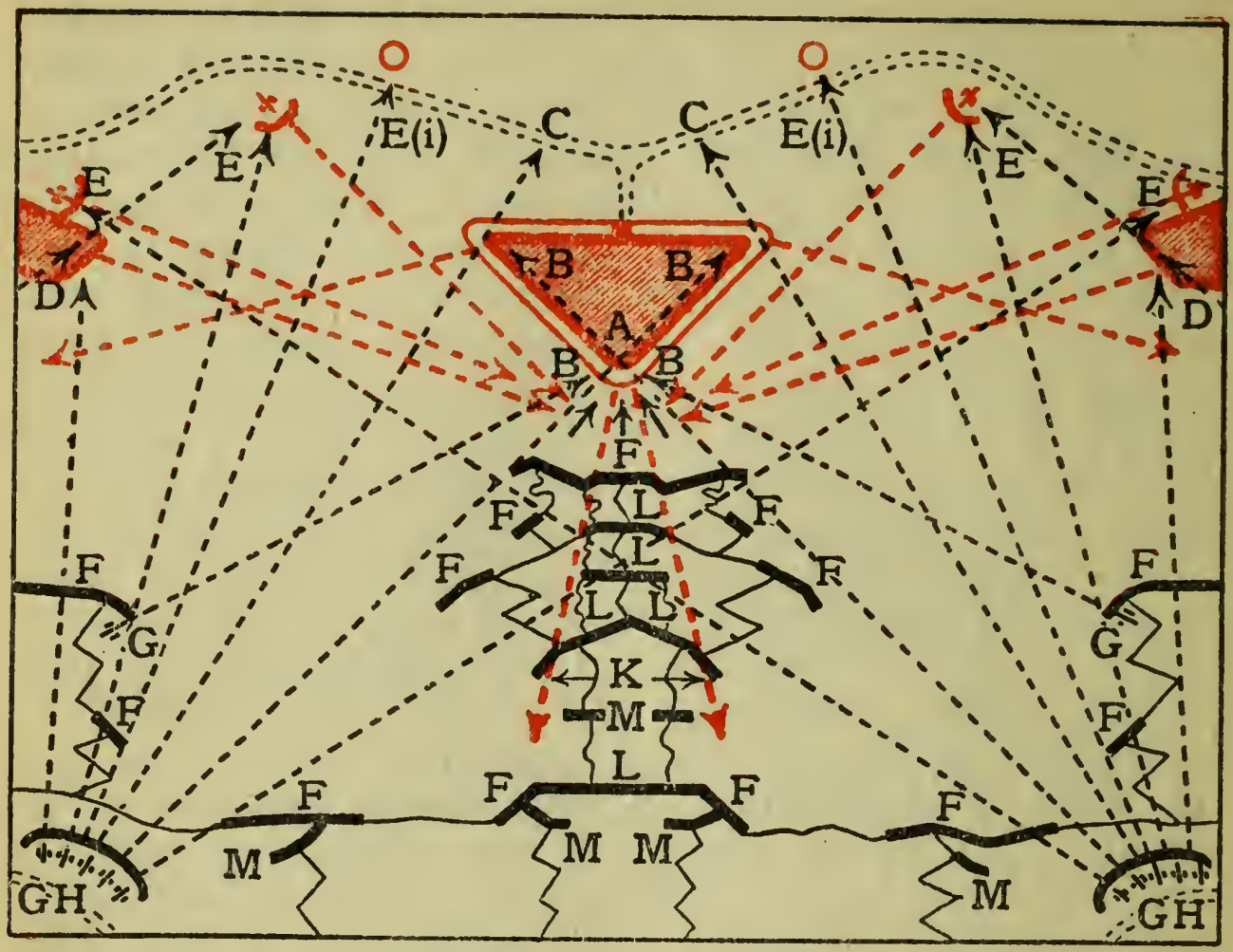


Fig. 69.—Diagram to illustrate the Approaches, Covering-Fire, and Artillery Support required by Riflemen in the Assault of a Strongly Held Earthwork. The Defenders' Earthworks and Lines of Fire are shown in Red and those of the Attacking Force in Black. The Approaches are shown in Thin Black Lines.

A, Point selected for assault. *B*, shrapnel fire to clear the selected point. *C*, shrapnel fire to keep off reinforcements. *D*, shrapnel fire to keep down rifle cross-fire. *E*, *E* (i), Shrapnel fire and high explosives to keep down gun-fire and destroy observing-stations from which it is directed. *F*, infantry fire-trenches, with communication trenches. *G*, *H*, guns and howitzers, not arranged like this, but according to the requirements of each case. *K*, ground offering the best line of approach to *A*. *L*, additional cover

As a "salient angle" of the work is almost always associated with a spur of the nature described in para. (i) (*a*) above, most successful attacks have followed this particular combination in selecting a point of entry into the enemy's firing-line. Such a salient also usually lends itself well to artillery cross-fire in support of the attacking infantry.

5. Notes on Fig. 69.—(i) Fig. 69 shows, as a conventional diagram, an imaginary approach to a selected point in a defence work, and the five chief ways in which the attackers' artillery are required to help the riflemen when they deliver their assault from their foremost trench. These are—

(*a*) To clear the enemy's riflemen away from the point selected for attack and keep them down under cover.

(*b*) To prevent reinforcements from making use of the roads, etc., which would enable them to reach the work or the selected point.

(*c*) To keep down any cross-fire by the enemy from his "next door" works.

(*d*) To silence those of the enemy's guns which can most injure the assaulting riflemen.

(*e*) To destroy the observing stations from which the enemy direct their fire.

(ii) Among other points which may be noted from this diagram is the fact that a firing-line cannot be bent back to a sharper angle than about 120 degrees without causing "dead ground," since the rifleman can only fire with effect about 15 degrees right and 45 degrees left of straight ahead.

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in which to collect men for the assault (these have been fire-trenches at an earlier stage). *M*, store-trenches for reserves of tools, grenades, water, etc.

Note.—Obstacles have not been shown. The artillery can help to cut through wires or fill up ditches by high explosive shell-fire from their heaviest howitzers. Light guns and mortars must be pushed forward right into the infantry fire-trenches.

6. Sapping.—(i) *Sapping must never be resorted to while manœuvre is possible.* When the attack reaches a stage at which it becomes impossible for men not only to advance above ground, but even to dig with any part of them visible to the enemy, an approach-trench can only be advanced by men who stand out of sight at the bottom of it, and extend it forward at its full depth *in the direction of its length.* That is to say, that the rate of advance depends entirely upon the rate at which the one man at the head of the approach can excavate, while those behind dispose of the earth. This method of advancing an approach is called sapping.

(ii) As a rule it is only possible to work at a sap during such times as the enemy cannot see the head of the sap to aim at it with their quick-firing artillery. This limits progress to times of darkness, fog, or heavy mist, or when passing through small dips or accidents of the ground which conceal the sap-head from the view of the enemy; but whenever the enemy's fire slackens, for however brief an interval, work must press on at top speed. Advantage must also be taken of any opportunity which arises to push ahead by ordinary trenchwork—that is to say, to extend a continuous line of diggers on ahead to work down from the surface in the usual way. Work may be accelerated by placing a continuous line of steel shields or a sandbag wall on ahead during darkness, behind which men can work on the surface in the usual way.

(iii) **Sapping Detachments.**—Details regarding sapping detachments or gangs, together with the method of executing the work, will be found in Appendix V, p. 206.

7. Depth of Approach-Trench.—(i) No exact depth below ground can be laid down for the bottom of an approach-trench, whether formed by ordinary trenchwork or by sapping. *The quickest safe path forward must be taken by the quickest method which the moment permits.*

(ii) It is a great advantage if it is possible to avoid throwing up any earth parapet at all, as this marks the exact point of the sap-head, makes interference by the enemy easy, and enables them to decide whether work is in progress or not. For these reasons, when passing over ordinary ground, the approach should be cut about 6½ feet deep, and the earth sent away back along the trench to the first spot where it can be dumped out of sight of the enemy. Unless the trench is cut deep enough to screen a man standing upright, since it runs more or less directly towards the enemy, the men at the head of the trench will always be exposed to fire, and a substantial protection, either heavy steel plates or about eighty sand-bags, must be placed at the head. The time wasted in continually moving this screen a little bit forward makes the actual rate of progress of a shallow trench no faster than one cut clean down to the full depth.

(iii) If the path, however, passes through a dip or hollow, or other place which enables this screen at the head to be dispensed with for a time, the quickest progress will be made by digging down only about 4½ feet, and throwing the earth as a parapet to bring the cover on the exposed side up to about 7 or 8 feet in all. In passing over extremely hard ground, such as solid rock, it may be necessary to have the *whole path at ground level*, and to build up a solid protecting wall on each side of the path by means of sacks or bags of gravel, etc., brought from a distance and placed one at a time, possibly at a very heavy cost in casualties, for the approach must continue without one moment of avoidable delay.

8. Width of Approach-Trench.—(i) The width cut *by the leading man*—irrespective of depth—should be the narrowest in which he can work without the sides of the trench falling in. This man is only responsible for keeping *proper direction** and the *proper depth*. In firm soil the smallest

* Any alignment which can be enfiladed must be avoided.

cut in which a man can work at 6½ feet below ground will be about 2 feet wide at the top and 1½ feet wide at the bottom.

(ii) The men behind the leading man must widen the trench to the full normal width, which is 3½ *feet wide* at the bottom of the trench. It may be necessary to widen these approaches still more as time goes on; and if guns are to be taken along them, a bottom width of 6½ feet will be required. The top width will, of course, depend upon the steepness at which the sides will stand, and will not be less than 4 feet. It may be necessary to shore up the sides of the trench with timbers, the struts being kept high enough for men to pass easily beneath them.

9. Rate of Progress.—For an approach-trench, cut by sapping, through average soil, and 6½ feet deep, without interruption from the enemy, the rate of progress may be estimated at from 1½ to 2½ feet forward per hour of actual work. Thirty feet, or 10 yards, per day of twenty-four hours in the close presence of a skilled and determined enemy would be fast progress as a daily average.*

10. Underground Approaches.—When open approaches can no longer even be sapped towards the enemy, it will be necessary to roof them with splinter-proof cover as they proceed. When this is in turn no longer possible, the time has arrived for burrowing entirely below ground. If it is required to emerge at surface-level before reaching the enemy, explosives should be used to complete the approach to the surface, the débris affording cover for men as they emerge. If the explosion can be arranged directly beneath the enemy's advanced works, it will be an advantage.

* The Japanese during the siege of Port Arthur in 1904, at a distance of 100 yards from the enemy, are said to have advanced their sapped approaches in particular cases as much as 15 yards in the course of a night.

Section 25.—Parallels.

1. Reference has already been made to the fire-trenches, or parallels, which are required to cover the construction of the approaches leading to the final fire-trenches, or last parallel, from which the assault is to be delivered. The following points must be kept in mind in arranging for the establishment of these attack fire-trenches. It will be seen that they differ to some extent from fire-trenches prepared principally for defensive purposes, or in the early stages of an attack.

(i) **Number.**—As few fire-trenches as possible should be made—only sufficient to obtain the fire effect necessary to enable the attackers to push forward to the final position for assault, and to beat off sorties or counter-attack, in co-operation with artillery and adjacent fire-trenches.

(ii) **Proximity to Enemy.**—The first line of entrenchment and each succeeding advance should be made as near to the enemy as possible, to avoid a long and tedious series of struggles for the foreground. Advantage should be taken of good opportunities, such as a dark night, to push forward as far as possible and entrench, if necessary, under cover of a line of steel plates.

(iii) **Concealment.**—Concealment of work done so close to the enemy is as a rule impossible; therefore the parapets must be stronger and the cover behind deeper than in ordinary defensive fire-trenches, as the enemy may turn very heavy shell-fire on to them at close ranges.*

(iv) **Head-Cover and Loopholes.**—Strong head-cover is essential. Loopholes must be as close together as possible to give great local intensity of rifle-fire. The holes in the steel loophole plates must be as small as will allow a man

* Before Port Arthur the Japanese made attack fire-trenches which provided cover 12½ feet deep.

to see over his sights. The steel plates themselves should be a full ½ inch thick, of the hardest steel, and may be bent forward in the middle, so that the average bullet will tend to glance off into the parapet earth. Proper steel hoods shaped to provide overhead cover as well as loopholes should be provided, if possible. Hard steel plates fitted with a prop, are an article of store.

(v) **Overhead Cover.**—Strong overhead cover is also essential. It should extend completely over the parallel. Pending the addition of such a roof, wire netting may be placed temporarily in order to intercept hand grenades and fire-balls intended to fall in the trench.

(vi) **Traverses, etc.**—Frequent traverses, firing-recesses, and good drainage are necessary as in ordinary fire-trenches. The passage round the ends of traverses must be made full width for easy movement along the trench.

(vii) **General Arrangements.**—As troops will usually be on duty in a parallel for at least twenty-four hours, full provision must be made for latrines, cooking and water supply; also a liberal provision of waterproof canvas with which to rig up weather-awnings and to spread on earth steps, etc., used as seats, or to lie down upon. Inflammable material, such as straw, brushwood, etc., should not be collected in such trenches.

2. Formation of the First Parallel.—(i) When it has been decided to join up into a continuous trench the hasty fire-cover, rifle-pits, etc., formed by the original firing-line of the attack at the farthest point to which it succeeded in advancing above ground, it will be necessary to make definite arrangements—

(*a*) To bring forward additional men provided with full-sized picks and shovels for digging.

(*b*) To send up additional tools for use by the men already holding the firing-line, and a fresh supply of ammunition.

(*c*) To establish covering fire-positions definitely intended to prevent interruption of the work.

(ii) **Covering Fire.**—These positions should seldom be straight in front of the working party, even supposing it to be possible to maintain them there. They are usually better slightly in advance of the flanks of the working party, so that they can bring a cross-fire on to the enemy should they attempt a sortie, and, if engaged at night, will tend by the flashes from their rifles to distract the enemy's fire from the men at work.

(iii) **Protection.**—As a general principle, these covering-troops should be established as for an ordinary outpost-line, with sentries and pickets, supports and reserves. At night outlying scouts should invariably be pushed right forward until they are close enough to detect the least sign of the enemy preparing for a sortie, and to give the alarm, besides making a careful reconnaissance of the ground and any obstacles.

(iv) **Alarm-Signals.**—A rifle-shot is worse than useless as an agreed alarm-signal under such circumstances, because casual shots, desultory sniping, and occasional bursts of heavy firing are chronic accompaniments of all close-quarter warfare. Next to portable telephones, *coloured lights** are the most reliable signals under these conditions, as the colour can be varied should the enemy join in the arrangement and give false alarms. Electric torches are also useful for signalling actual messages.

(v) **Firing.**—Needless to say, the covering-troops should do nothing to attract the enemy's attention, and should not fire unless there is no doubt of the enemy's intention to attack in force. Every man of the working party will have his rifle and accoutrements within reach of his hand without leaving the cover of the trench, and must thoroughly

* The "Very" signal pistol is supplied for such purposes. It fires a coloured star 300 feet into the air, burning for nine seconds.

understand that he is there to dig, and is on no account to lay down his tools and take up his rifle without a direct order to do so.

3. Preliminary Considerations.—(i) Before joining up any series of pits into a continuous trench, careful thought must be given to two other points:—

(*a*) The best places at which to leave blocks of ground to act as traverses to the trench.

(*b*) The best places from which to push forward or break out approach-trenches for the subsequent advance.

The traverse question has already been dealt with when dealing with fire-trenches generally.

(ii) *It is important that the enemy should not be able to detect the points at which approach-trenches start forward from a parallel* If they are cut straight forward through the parapet, the gap will betray the starting-point until it has been bridged and covered over again. A better plan, therefore, is to lay down at night stout planks—say, from 4 to 6 inches thick—on two ground-plates, supported on the natural surface of the ground, at the points selected for breaking forward with new approach-trenches, before commencing to throw up the parapet of the parallel. The two ground-plates are laid about 10 feet apart, end on to the enemy. It will then be easy to tunnel out under these planks without disturbing the parapet above. Sufficient planks to cover the ground for at least 10 feet to the front should be laid down, and all must be concealed with a layer of earth before daybreak.

(iii) Owing to the great variety of the ground features which will usually be found in the course of a systematic approach to any point from which it has been determined to dislodge an enemy, no definite system of regular alternations of approach-trenches and parallels must be contemplated as a fixed method to be adopted, regardless of the ground. For instance, such a symmetrical arrangement

as that shown in the form of a diagram in Fig. 69 would never be reproduced on real ground. Sound principles must be applied intelligently to varying conditions.

(iv) In the course of an attack, portions of approaches will usually be found suitable as fire-trenches, and portions of parallels will become approaches or communication-trenches, as conditions vary from time to time. All forms of trench-work may be carried out either by ordinary digging down from the surface or by sapping them in the direction of their length, or by a combination of both methods according to circumstances, every opportunity being taken to adopt at each instant the best method of attaining the desired object—namely, without undue waste of time, labour, or life.

Section 26.—Defensive Tactics against Advance by Covered Approaches.

1. Tactics of Defenders.—Exclusive of heroic measures, such as sorties of the whole garrison with a view to a grand counter-attack on the attackers, their lines of communication, or advanced depots of supply, or merely for withdrawal before it was too late, the following methods have been adopted, with varying success, by defenders to avoid local defeat at any point threatened with the form of attack described in this chapter.

(i) A vigorous policy of *counter-approaches* to keep those of the attacker at a standstill, and gradually to regain lost ground.

(ii) Continuous concentration of heavy fire upon the heads of all approaches.

(iii) Local sorties and the repeated destruction of sap-head detachments.

(iv) A local sortie designed to distract the attacker's

covering-fire from particular approaches, while a second sortie acts as in (iii), and deliberately fills in as great a length of approach trenches as possible.*

(v) Counter-approaches directed towards particular spots from which a galling enfilade fire can be brought to bear upon the attackers' approaches.

(vi) As in (v), but only with a view to accurate direction and observation of fire to be delivered from elsewhere.

(vii) Counter-approaches directed against a particular approach away back from the front, with the intention of isolating a large block of the attackers' approach works, filling them in, or permanently starving them of reinforcements.

(viii) Counter-approach by mining below ground, and blowing up selected points in the attackers' approaches.

(ix) A policy of continuous interruption of work by grenades or small bombs thrown by hand, rifle, or short-range mortars.

(x) As in ix, but with bundles of burning rags, fire-balls, etc., followed by a jet of oil from a powerful pump.

(xi) Continuous interruption by flooding with water from powerful pumps.

(xii) Keeping electric searchlights fixed on sap-heads all night in order to facilitate Methods ii, ix, x, or xi.

2. Of the above tactics, No. i is the only one which can be recommended with any reasonable prospect of enduring success, though all of them may serve to gain time, if time will mean relief from outside or exhaustion of the attacker. In every case in which the defenders make a local sortie, which is repulsed, the attackers should never fail to endeavour to follow them up and right into the defenders' lines or works with every available man.

* Another advantage of the deep approach trench (p. 143), with all earth removed, is that *there will be no loose earth for the enemy to shovel in during a sortie.*

Section 27.—Communication Trenches in Defence.

1. The provision of good trenches for communication between the different parts of a position entrenched primarily for resistance, is an easier problem than their provision in the attack, but not less important, and to be effective will entail a far greater actual expenditure of labour, as they may include not only safe paths for foot-traffic, but sunken ways for pack transport, and sunken roads for wheeled artillery.

2. (i) The following guiding principles must be applied by the rifleman in solving the problem of communications in defence. Although such communications cannot all be excavated or constructed at once, the safest routes can, and must, be selected provisionally and marked out without delay, so that they can be followed by night or day. This selection should be done *concurrently with the entrenchment of firing-points*. Cover from view is essential, for the enemy will not fire upon communications if they do not know when they are in use.

(ii) Where concealment of the firing-points forms part of the defensive scheme, *visible communication-trenches must not be dug leading to them.* In such cases, as on a forward or downhill slope towards the enemy, the communication-trenches must either be carefully concealed or omitted altogether, and traffic only permitted at night.

(iii) Communication paths or trenches leading from one firing-point to the next on its right and left should as a rule be directed well back to the rear before leading off in the required direction.

(iv) **Guide Marks.**—The guiding principle in marking out a path or track for night use is that each guide-mark should be visible from the last. White patches, paper lanterns, etc., may be used for guide-marks. A single plough-furrow

is not a bad guide, and can often be drawn from point to point in deliberately prepared positions.

(v) **Shape and Depth.**—No special shape or depth of trench can be laid down for universal construction. At first it should be the least elaborate which will suffice; it can then be improved later. A glance at Figs. 70 and 71 will show

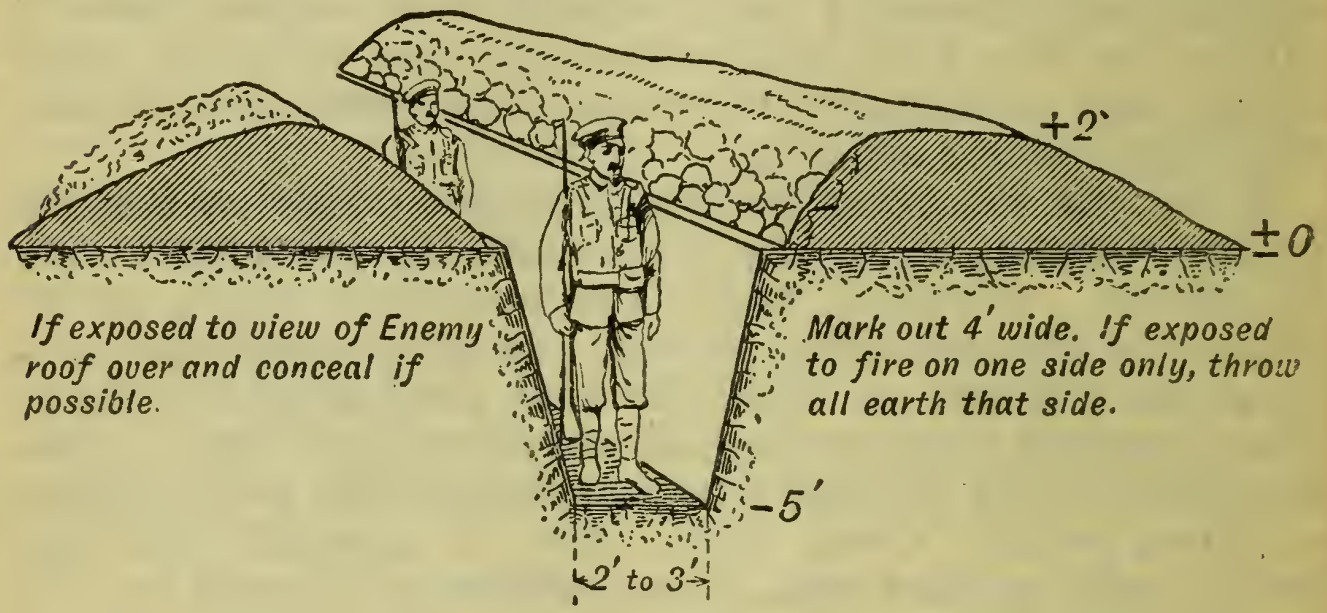

Fig. 70.—COMMUNICATIONS: A PASSAGE TRENCH FOR FOOT TRAFFIC.

typical examples of an excavated passage-trench for foot traffic, and a typical arrangement of such a trench leading from supports to a firing-line.

(vi) Time and labour can be economized by a skilful use of the ground, and by reducing the distance between supports and firing-line as much as possible.

(vii) **Parapets.**—These trenches may require parapets on both sides, or only on one side, according to their exposure to fire. If liable to be swept by enfilade fire, they should be traversed in the usual ways—either by pointing them clear of danger-spots held by the enemy, or by providing tongues of earth across them at frequent intervals. In

exposed places the trench should be dug at least 7 feet deep.

(viii) **Roofed Communications.**—If it is foreseen that communications must be roofed over, either for concealment or

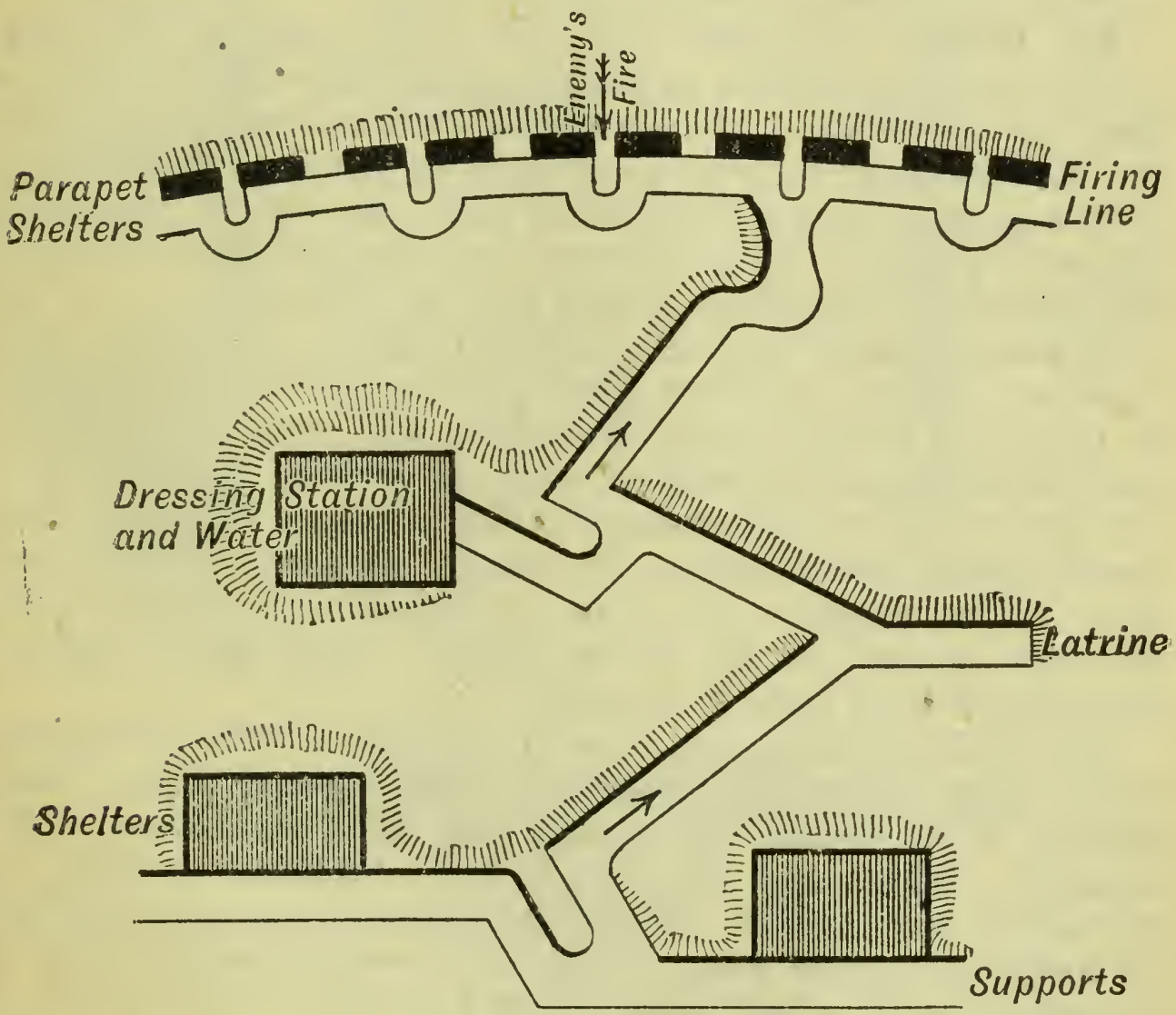

Fig. 71.—Typical Passage Trench from Supports to Firing-Line.

safety, they should be dug sufficiently deep to place at least 9 inches of earth over the roof cover, *and to restore the ground-surface to its natural appearance as far as possible.* Should it be unavoidable that earth must be heaped

up over the roof, if it is shaped up to look like a small bank or hedgerow, and bushes or vegetation, or even a rough post-and-rail fence planted along it, it may escape undue attention from the enemy provided they can see along each side of the apparent bank, hedge, etc.

(ix) **Recesses.**—If there is much traffic along a communication-trench, recesses or passing-places should be made at frequent intervals. Use should be made of existing ditches, fences, low ground, etc., to economize labour, remembering that a screen from view is often sufficient except over very exposed ground, where the communication for service of ammunition or messages must not be delayed.

3. Communication with Lookout Men.—(i) Where sentries or lookout men are posted away from their pickets, or from the general firing-line, deep and very narrow communication-trenches will be required leading to their lookout posts. These trenches should be most carefully concealed, and should show no earth parapet. They may have to be roofed. *There is no obligation to post the lookout men actually in the firing-points.* They will be where the best field of view is obtained.

(ii) If the lookout men are in advance of the firing-line, they must be fully protected from reverse fire. They should be in signal communication also with their commander. This may be either by telephone, a bell, or miniature semaphore. Sufficient lookout men are required to keep the whole field of fire and every possible line of approach under close observation by day.

(iii) It is not advisable to allot an arc of more than about 45 degrees to one observer if he has to watch any great distance ahead for signs of the enemy or their movements, though his actual loophole should permit of a view of about 60 degrees of foreground, if possible. Since these lookout men must remain on duty under artillery-fire, storm, and tempest, their protection and concealment are of the first

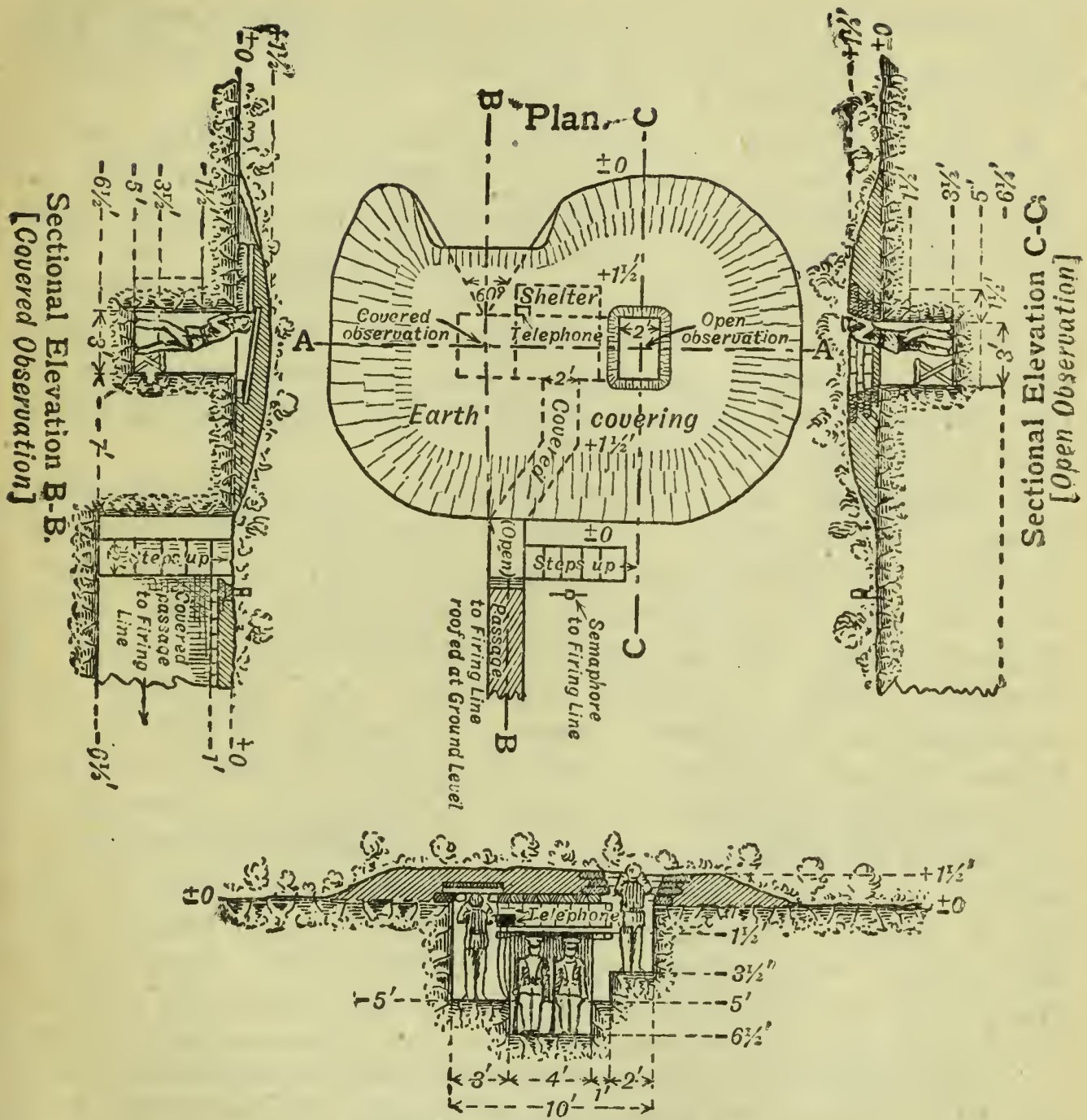

Fig. 72.—Protected Lookout Pit for Two Observers in Front of Firing-Line, with Splinter-Proof Shelter and Covered Passage for Communication.

Note.—Total excavation of pit, shelter, passage (as far as steps), and steps, is from 350 to 400 cubic feet, according to stiffness of soil. This should take five men about four hours; roofing,

importance. They are therefore often better away from visible or partly visible firing-points, provided communication can be arranged with them.

4. There should be steps or means of climbing out of the narrow trench which leads to such a lookout post, so that night patrols can also make use of the path when proceeding from and to the main firing-points. By night the lookout men would generally be posted differently, usually nearer the main firing-points, and often more especially to watch fences, artificial obstacles prepared by the defence, and existing roads or easy approaches which may be used by the enemy.

5. Examples of Lookout Pits.—(i) Examples of small lookout pits are given in Figs. 72 and 73. Fig. 72 shows a simple pit measuring 10 feet by 3 feet at the bottom. At one end an observer standing about 5 feet below surface looks out at ground-level through a Type B loophole, with a shallow opening. At the other end a second or the same observer, standing about 3½ feet below surface, can look out all round, or use a one-man range-finder through a hole about 2 feet by 3 feet left in the earth covering the roof. In the centre a "two-men" shelter is made, and covered before the rest of the pit is roofed. A sunken passage-trench leads back to the firing-line, with steps up to surface-level just outside the pit for the use of patrols, etc. A man standing halfway

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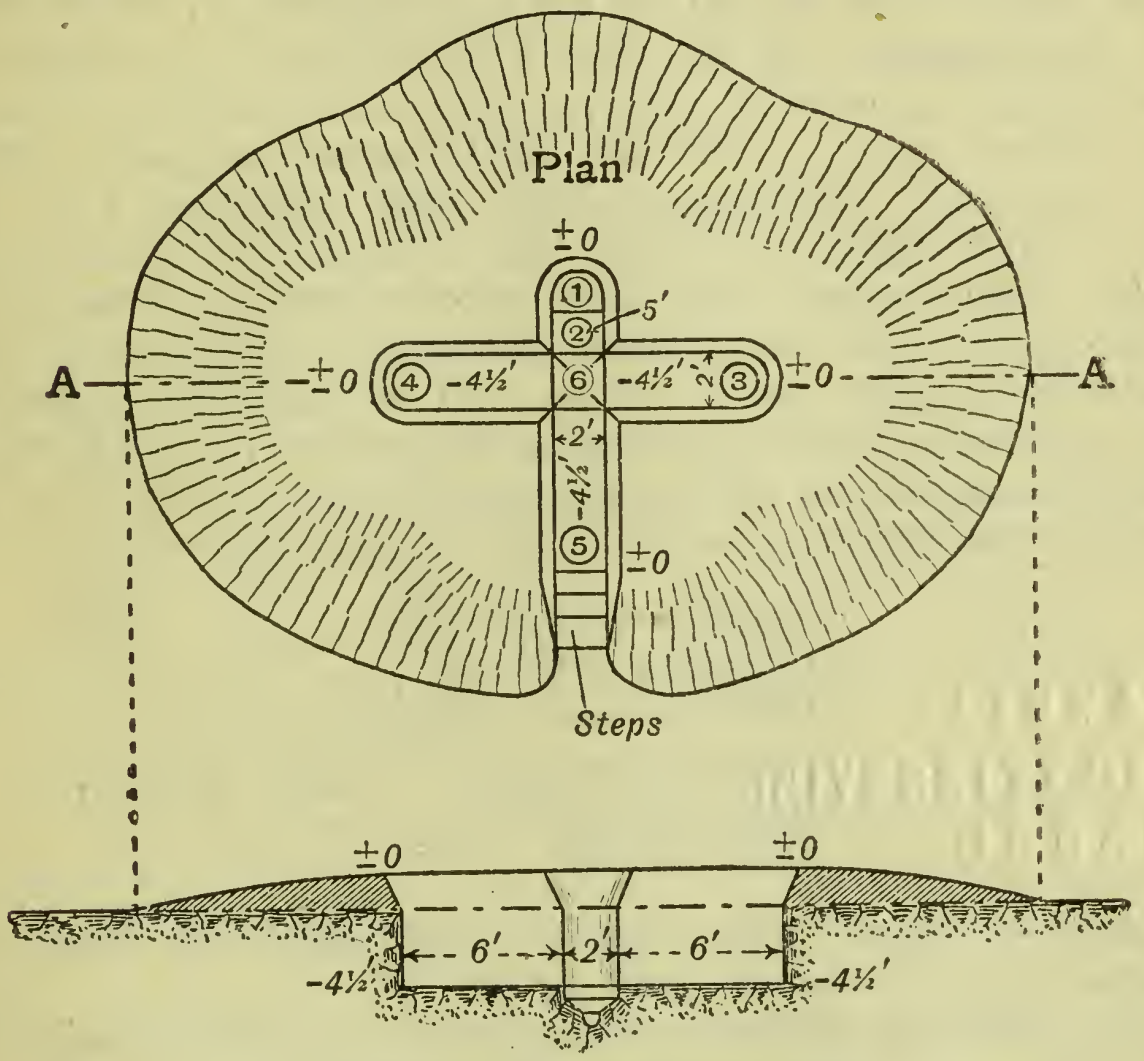
replacing earth, and concealment, etc., another four hours. For roofing allow about 150 feet super of 5-inch stuff, equal to about twenty old railway-sleepers, or forty 5-inch poles in 9-feet lengths. For revetting steps, etc., allow about 50 feet super of 1½-inch boarding; and for roof opening and earth replaced over the shelter, etc., allow fifty sandbags. (No allowance in above for general earth revetment. The soil is assumed to stand at ¼ below surface where not exposed to weather.)

up these steps can signal by miniature semaphore under cover of the roof mound of the pit.

(ii) Fig. 73 shows cover suitable for a small observation



Sectional Elevation A-A

Fig. 73.—Hasty Cover for Observation and Fire by a Group of One Leader and Three Men.

1, Sentry's firing recess; 2, sentry's observing step (6 inches lower); 3 and 4, fire and sleeping recesses for men not on sentry duty; 5, leader's recess, and for fire to a flank; 6, drain or soak-pit.

Total excavation = 150 to 165 cubic feet, according to soil. Two hours' work for three men (with one on sentry duty = four men). Single parapet shelter recesses (Fig. 26) should be added when possible.

group, as in an outpost-line. This form lends itself well also to all-round resistance by a small party, and the example shown should be made easily by three men in two hours' work, which does not allow for concealment or revetment.

6. Signboards.—(i) All tracks to be used as communications must be labelled clearly. To be of service at night, the notices must be written on transparent paper affixed to a lantern. The lantern need only consist of a tin box with a night-light or candle, but it must be placed under cover from heavy rain, and men must be detailed to patrol them and keep them effective. For use by day, small signboards are required. It is specially important that a strange orderly should be able to find his way to the officer in command of any group of firing-points.

(ii) Other signboards are required pointing to—

Telephone shelters.
Dressing stations.
Reserve ammunition.
Latrines.
Reserve water.
Tool depots.

Each of these places should also have an *identifying number—e.g., Dressing Station, No.* 3.

(iii) Ordinary shelters, as previously noted, should have the *maximum accommodation* in men marked at their entrance, as well as an *identifying number*. Recesses for hand grenades and rifle ammunition should have the *number of rounds* to be maintained marked on them. Men must be told off to make good these amounts after every expenditure.

CHAPTER VIII

OBSTRUCTION

Section 28.—General Remarks.

1. The best form of obstruction to the enemy's attack lies in the defender's power of offence—in the case of infantry in the effective use of the rifle. Obstruction may be passive or active. Obstacles may therefore be considered under the two general aspects—(i) Passive obstruction, which only *delays* without directly assisting to *destroy* the enemy, except perhaps in very small numbers; and (ii) active obstruction, which is specially intended to assist the rifleman to inflict a greater loss on the enemy than he could otherwise do.

2. Artificial Passive Obstruction.—Artificial passive obstruction is usually carried out at some distance from the firing-points. It has to be done on a grand scale to be of any appreciable value. Examples of such obstruction are increasing the difficulties of the enemy's *movements* by spoiling some of his main communications; destroying, blocking, dismantling, or flooding important roads, railways, bridges, tunnels, viaducts, fords, docks, dock-gates, wharves, and wharfside machinery, river locks and sluices, telegraph and telephone lines, and cables by land and water; destroying or removing all means of transport, rolling stock, carts, waggons, motors, barrows, ships, boats, and flying machines.

3. Active Obstruction includes all measures directly intended to assist the rifleman to increase the effectiveness of his own fire or to depreciate that of the enemy, exclusive

of those measures which, with the same purpose in view, are based upon the protection afforded by cover, concealment, or facilities for communication. The principal measures of active obstruction available in ordinary field warfare in active defence are as follows:

(i) **Ambush.**—The use of advanced troops to decoy and hustle the enemy into areas in which arrangements have been made for their destruction under circumstances favourable to the defenders. Mounted troops are specially useful for this operation. It is, of course, assumed that the riflemen available are too few in numbers to undertake an active attack. This method should always be employed in order to influence the direction of the movements of a more numerous enemy advancing towards an area prepared for active resistance by a small number of troops. If well and boldly carried out, the advantage of the defender's preparations by entrenchment, ambush, and concealment in chosen firing-points, has often been reaped to the full. The execution of such movements is a tactical study beyond the scope of this book.

(ii) **Improving Field of Fire.**—Altering and improving the foreground of the prepared firing-points so as to decrease the area of ground within close range on which the enemy is not visible or under fire from as many firing-points as possible.

(iii) **Spoiling Cover for the Enemy.**—Altering and improving the foreground so as to spoil as many firing-points as possible which might otherwise have been of use to the enemy.

(iv) **Firing at Known Ranges.**—Placing marks at measured ranges clearly visible to the riflemen in the firing-points from which they are measured.

(v) **Artificial Obstacles.**—The construction of artificial obstacles.

(vi) **Mechanical Signals.**—The use of mechanical alarm signals operated involuntarily by the enemy.

Section 29.—Improving Foreground for the Defence.

1. The improvement of the foreground is the first measure to be undertaken after the firing-points have been chosen. The first cardinal principle of good preparations for defence (see p. 6) is *the choice of the firing-points* after a complete study of the features of the ground, with due regard to tactical requirements and economy in men. The second cardinal principle is that *the enemy, in attacking, should be continually exposed to the fire of the defenders, more especially for the last* 300 *or* 400 *yards.*

2. Dead Ground.—(i) The modern method of carrying out this principle in practice is to arrange to command all dead ground by *judicious siting and grouping of the firing-points, and co-operation with the artillery, to ensure that no ground of any value to the attackers is left unswept by fire.*

(ii) **Clearing and Levelling.** — Clearing and levelling must be undertaken most cautiously and judiciously, for very little can be done on such a large area of ground without much labour and the danger of betraying the preparation of the position. These measures, therefore, should only be undertaken when they are absolutely essential, and when results fully justify them.

(iii) **Co-operation.** — It will not be possible in average country to ensure that every fire-trench commands all its own foreground, including dead ground. This difficulty may be solved through *co-operation between the various firing-points* in a defensive position, which should be sited to facilitate not only co-operation between neighbouring firing-points, but between distant points when necessary, and also by co-operation between the firing-line and artillery which may fire on ground, especially with howitzers, which cannot be swept by the bullet owing to its flat trajectory.

3. General Rules for Improving Foreground.—(i) It is, of course, impossible to define measures for improvement of foreground which are applicable to every foreground, but the following general rules may be applied with advantage:

(ii) The siting of the firing-points and the search for dead ground are mutually interdependent, and will generally be considered in relation to one another. The most adverse circumstances to be faced, especially at night, must be kept in mind.

(iii) Rifle-fire should sweep every spot on the ground where, say, ten or more of the enemy could otherwise lie in safety within 400 yards of the firing-points. The ground should be dealt with working forward from the firing-points towards the enemy.

(iv) *Lines of view* from the firing-points which bear on these "dead spots" should be improved so that they include the full dead frontage, even if improvement only consists of lopping off a few branches or cutting one or two gaps at certain points in a hedge.

(v) Frontal fire should not be sacrificed by distorting main firing-points to deal only with some particular contingency or to command some spot of dead ground.

(vi) Simple alternative firing-points should be provided, and schemes for distribution of fire to meet day and night or normal and abnormal circumstances should be arranged. The utmost value should be obtained from each rifle under all circumstances with as little movement of troops as possible.

(vii) Dead spots which cannot be searched effectively with rifle-fire should be marked carefully on the ground, and, if possible, on a large-scale map, *at the points at which attackers would reappear on the defenders' side of the dead area.* The nature of the mark is immaterial, but it must be distinctly visible, and its range must be known to those

concerned, including the artillery officer, who, as soon as his guns are sited, should, when possible, fire a few ranging shots at the places in question until he is satisfied that he can burst shell there again on demand.

(viii) A short name for each dead spot should be agreed on, so that the signal, "Shoot June," or "June minus fifty" (yards), will produce an instant and effective response (Fig. 74).

(ix) In addition to artillery support, a certain strip of ground which *must be crossed* by the enemy immediately they leave the cover of a dead-spot should be commanded by rifle-fire, together, if possible, with another strip beyond the dead spot which must be crossed by the enemy when making for the cover of the dead-spot in support of their firing-line.

(x) **Avenues.**—If the dead spots are too numerous or too close to the firing-points, as may be the case in close or wooded country, with many accidents of surface and plentiful vegetation, the defence must at least arrange to sweep with rifle-fire by both day and night selected dead straight alignments or avenues of approach which intersect or overlap each other, and which *must* be crossed by the enemy.

(xi) This measure is always advisable during darkness or fog, and is specially employed in conjunction with artificial obstacles, fences, etc., as described in Secs. 32 to 38. If these avenues can be arranged so as to exclude the enemy from the shelter of dead spots, it will be an advantage, but the fact that they must be swept by grazing fire, if possible, from end to end will seldom allow the points at which they cross or overlap each other to be farther than some 300 yards from the firing-points, while for night use this distance must be reduced to considerably less.

(xii) In setting out the alignment of such avenues it is important to follow the smoothest and most even natural

ground-surface available in order to reduce the amount of work to be done to bring the whole avenue under fire.

(xiii) It is a further advantage if the points at which two avenues intersect or cross can be arranged to coincide with the exits from dead spots, so that a cross-fire will greet those emerging from them, and also if the mark referred to in (vii), above, is distinctly visible from both the firing-points concerned.

(xiv) Even in fairly open country natural obstacles such as hedges, fences, roads, walls, etc., can often be found which lend themselves readily for the purpose of forming the alignment of these avenues, and may with little labour be made to afford sufficient check to the attackers for the defenders to clear the avenue by fire. The value of machine guns in regard to the above measures is obviously great.

4. Frontal Fire.—(i) It is necessary to emphasize the warning in para. 3 (v), p. 162, to the effect that the *main* frontal fire of entrenched firing-points must not be based upon a system similar to that described in that paragraph. This system is essentially adapted for *emergency* use, and for fire from emergency firing-points specially planned to deal with exceptional circumstances, such as a determined rush which will entail the constant crossing of avenues by successive reinforcements, and for night firing.

(ii) As soon as the most urgent improvements necessary to assist the defenders to deal with their foreground in the methodical manner indicated in the foregoing pages have been carried out, labour can be devoted to general improvements for frontal fire.

(*a*) *Hedges, Walls, and Trees.*—Those hedges, walls, etc., which it has not been arranged to sweep by enfilade or oblique fire should gradually be cut down, working forward from the firing-points as before. Large single trees ob-

struct the defender's view and fire less as a rule when standing than when felled, and a few branches sawn off will usually be the limit of profitable work.

(*b*) *Standing Crops.*—Standing crops can have rides cut through them on the principles above described, or can be reaped forward from the firing-points after leaving any fringe useful for concealment immediately in front of the firing-points. In a country where standing crops are found the tools for reaping them will not as a rule be far away.

(*c*) *Jungle, Undergrowth, and Woods.*—Thick jungle or undergrowth should be treated on the same lines, and the portions cut down used to block the edges of the portions left standing. The edges of woods also can often be straightened with a little labour, so that they can be swept by enfilade fire.

Section 30.—Spoiling the Foreground for the Enemy.

1. This operation is interrelated to improving the foreground for defence, but requires separate consideration, because it includes measures which might be neglected if only those which concern fire-effect were considered. These measures, moreover, may often serve for the purpose of active obstruction.

2. The measures which are most effective deprive the enemy of the use of all natural fire-cover which would tend to give him the similar advantages in this respect to those enjoyed by the defenders. They include—(i) spoiling the "firing edge" of dead ground—that is, the first points from which attackers crawling forward from the dead ground can see to use their rifles again; and (ii) levelling existing raised cover which may be used by the enemy.

3. **Ditches, Sunken Lanes, Hollows, etc.**—The firing edges of ditches, hollows, sunken lanes, brooks, etc., may be obstructed or spoilt by throwing in adjacent objects, such

as felled hedgerows, small trees, furze-bushes, etc., or filling them up by slicing down the bank on the defenders' side, or by collecting adjacent crops, stacks, farm implements, loose stones, etc., with which to fill in or spoil them. Tangled wire and broken glass may also be used to spoil cover when they are available, but the former would be better used out in the open in connection with the improvement of the avenues described in para. 3 (x), p. 162. Ditches, open drains, etc., can also be blocked up ready to gather water after heavy rain, and brooks can be dammed up with the same object.

4. Stratagem.—The enemy may also be deprived of the use of fire-cover by stratagem. For example, dwarf signboards fixed at the firing edges of dead ground marked "*Range 1300*," and greatly overstating the ranges, may cause the enemy to avoid cover as dangerous, because he thinks its range is known to the defender, and push on his advance to more exposed ground.

5. Raised Cover.—(i) Raised cover may be spoilt also, not by a wholesale attempt to destroy every building, wall, or bank, etc., in the foreground, but after careful selection of the features most useful to the enemy. Portions of walls may be knocked down and carefully scattered. Buildings in the foreground should never be burnt down or demolished with explosives, unless they will give less cover levelled than when standing, which is not always the case, especially as they may form a good artillery target for the defender while standing. In any case, every effort should be made previously to extract all woodwork, flooring, glass for obstacles, etc., which may be useful to the defender.

(ii) **Windows, Doors, Gates, etc.**—As a hasty measure, window openings facing the defender should be torn down to floor or ground level, and gates and doors, etc., nailed or wired up to make ingress difficult to the attacker. Field engineers may assist in this work by setting charges

of explosive which will wreck the building should anyone force some particular inner door leading to a room which offers fire-cover to an attacker. In any case stratagem may be resorted to, and the words "*Mined Building*"; "*Beware,*" or similar warning, should be visible to deter the enemy from using the building for cover.

(iii) **Bridges.**—All masonry bridges which cross railways, roads, etc., in the foreground should have the *near side* parapet wall torn down to road-level, so that traffic is clearly visible and the fire-cover spoilt.

6. Unspoilt Cover.—It is useless to waste time and labour in the *wholesale* clearing, levelling, filling of particular hedges, walls, ditches, of which *only small portions* can possibly be of use to the enemy. Time will seldom be available for the systematic spoiling or destruction of every vestige of cover which may afford the enemy concealment or protection. The position of such cover may, however, be noted, and arrangements made to command the ground in front of it with artillery and rifle fire.

Section 31.—Range-Marks.

1. The measurement of ranges will commence the moment a firing-point has been chosen. Range-taking increases in importance rapidly with every 100 yards beyond 600 yards up to 2,000 yards, at which distance troops not in a close formation are only visible when in motion, or with a very favourable background or light. Range-marks are of special value to the defenders in those firing-points in which they have been told off *to watch for and deal with the enemy's supports and reserves* during their advance, after fire has been opened and the enemy's firing-line is already pinned down, or is unable to cross the avenues referred to in para. 3 (x), p. 162, until strongly reinforced.

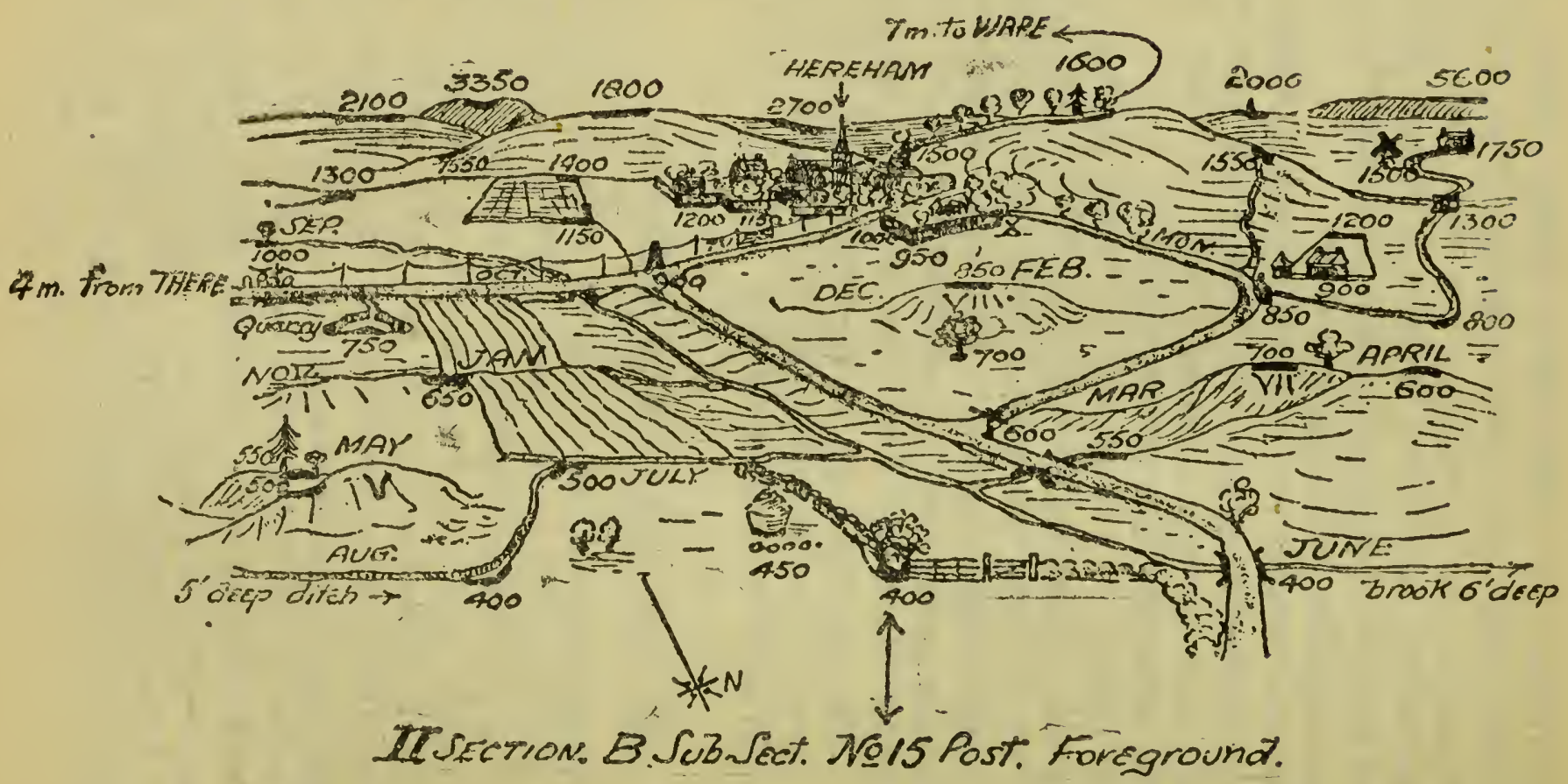


Fig. 74.—EXAMPLE OF A FOREGROUND RANGE SKETCH.

Note.—Ranged points are indicated by a thick line. The appearance of the Range-Marks is shown thus :—VIII • [= 850 yds.] Names have been allotted to important dead spots within 1,000 yards—*e.g.*, FEB. refers to the dead area immediately behind the ridge ranged as 850.

2. Important Points.—Points the range of which may be ascertained and marked with advantage include the exits and entrances to all areas of dead ground, or likely cover from view or fire; the crests or skylines—as seen from the firing-points—of all ridges and humps on the foreground; patches or lengths of roads likely to be traversed by the enemy; gaps and gates in fences; corners of fields and enclosures; bridges, culverts, etc.; and conspicuous single objects as guide-marks from which to estimate adjacent distances, such as isolated buildings, signposts, rocks, milestones, double telegraph-poles, or other such features.

3. Foreground Sketch.—(i) An example is given in Fig. 74 of a simple outline foreground sketch, on which has been recorded the range to a certain number of points on the ground. Names have also been allotted to patches of dead ground within 1,000 yards or so of the firing-point. The abbreviated names of months and days of the week lend themselves to such a purpose, though any other short names will do equally well (see p. 163).

(ii) Such a sketch would as a rule only be made in connection with very carefully prepared firing-points; but as from seven to ten hours or more is required to make any serious attempt to prepare and conceal a series of firing-points carefully, it is clear that the range-taking and range-marking party should have ample time to make an exhaustive reconnaissance of the foreground, to put out the range-marks, and to record their work in some simple form. One sketch such as Fig. 74 is sufficient for the commander of a group of firing-points.

4. Range-Card.—(i) Fig. 75 gives an example of a range-card on which are drawn lines actually pointing towards the targets the ranges of which have been taken. The targets themselves are indicated either by a conventional sign, such as a tree, house, etc., or by some concise descriptive word, and the range in yards is written at the

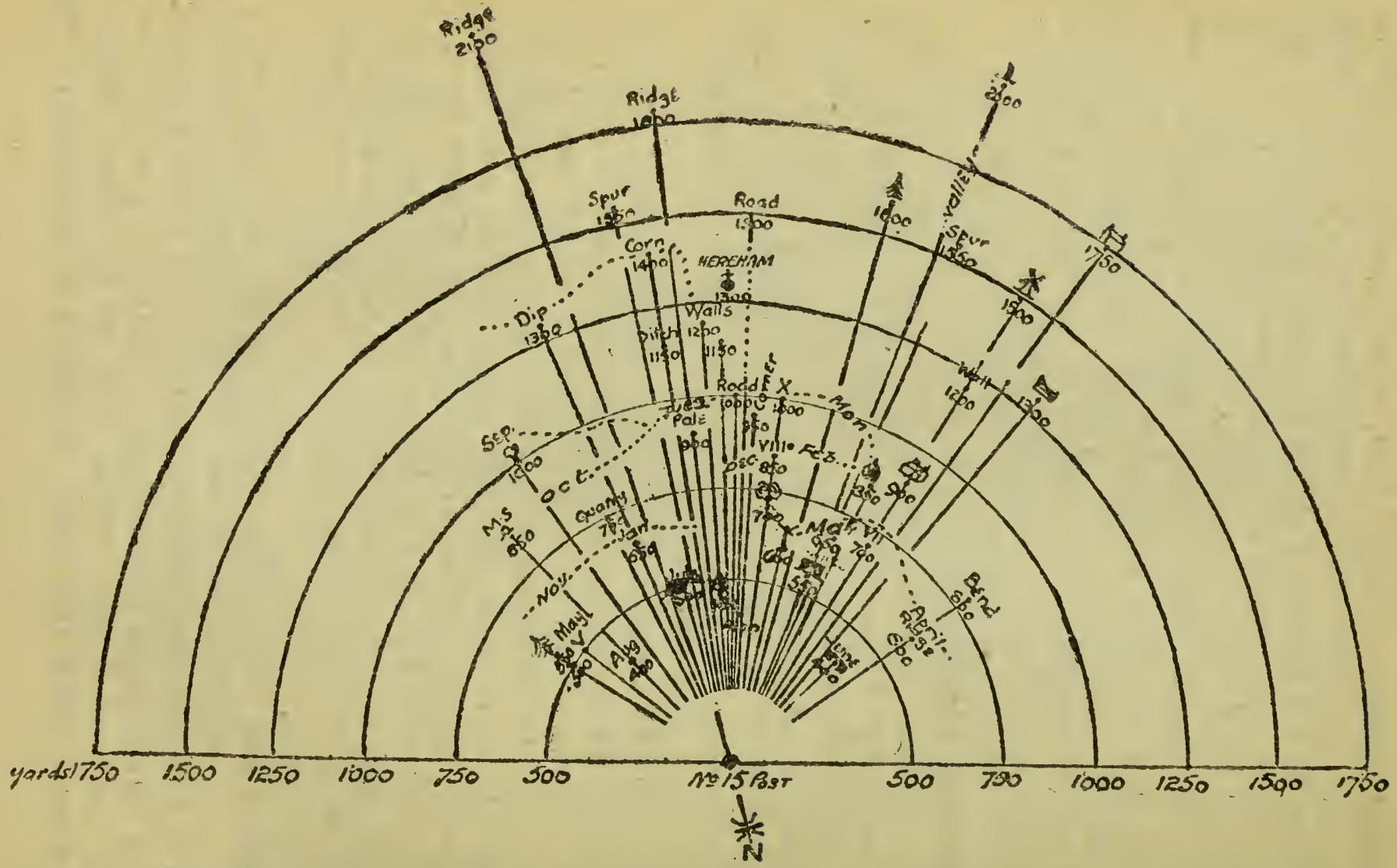


Fig. 75.—EXAMPLE OF A RANGE-CARD TO FOREGROUND IN FIG. 74. The gaps in the direction lines indicate the "dead spots."

Much reduced: a suitable scale is 6 inches to 1 mile.

end of the direction-line in such a way as to face the reader when he is using any particular line.

(ii) **Dead Ground.**—Gaps are left in the direction-lines where they pass over dead ground. This enables the fire unit commander to see all his dead spots at a glance, and shows also the lines of cross-fire which may be directed at them through co-operation by arrangement with other fire-points.

5. Preparing Range-Cards. — A range-card should be prepared for use by each N.C.O. or fire unit commander on outpost duty or in entrenched firing-points, and should be handed over to successors. The example in Fig. 75 contains many more ranged points than would usually be found on an average foreground. The best way to prepare a range-card is actually to use a piece of a large-scale map of the country on which to draw the range-circles and direction-lines. If the direction-lines are few and the names of the targets rather elaborate, it may be necessary to write the names and ranges *along* the lines, but by this method it is not so easy to find the range of any point quickly.

6. Marking Ranges on Ground.—(i) The actual marking of ranges on the ground by means of visible marks may be done as follows: Range-marks should be provided, and should be placed on that side of large trees, houses, banks, etc., which is only visible to the defence. The simplest arrangement consists of one white object per 100 yards range; 500 yards may be denoted by the sign V, made with two boards, poles, etc.; and 1,000 yards bythe sign X; intermediate hundreds being indicated by single objects in addition, as above described. On a bank or slope facing the firing-points Roman numerals may be cut out on the turf, etc., or formed by arranging stones or planks.

(ii) **Marking on Trees.**—For marking on a tree the hundreds marks must be one below the other, and patches of tin do very well for this. For marking " fifties " an object much

smaller but distinctly visible may be added, or one object quite different to the remainder. On a tree marked with tin discs, for example, half a disc would do for 50 yards.

(iii) **Marking on Buildings.** — For marking on a building, the colour to be used depends on that of the masonry, etc. A whitewash-brush is one of the best implements, if obtainable, and the marking can be either large Roman numerals or ordinary figures if they can be read clearly.

(iv) **Examples of Marks.**—In Fig. 74 five artificial range-marks are shown—namely, oooo·(450) at the stack, V on May hill, VII on March-April ridge, VIII·(850) on Dec.-Feb. ridge, and X where Monday road disappears into Hereham village. The walls round the village might be marked in a similar manner, but the sketch is too small to show the marks.

(v) **Size of Marks.**—A practical rule for the *size* of mark is 1 foot of height to the mark per 100 yards in the range, unless the background is very good—such as black spots on a white wall—when half this allowance will be ample.

7. Verifying Ranges.—Ranges should be verified by firing, whenever this can be arranged.

Section 32.—Artificial Obstacles.

1. In field warfare, the amount of artificial obstacles which can be prepared will be extremely limited, unless materials, time, and labour, are abundant, and great discrimination is necessary in order to make the most of available resources.

In connection with permanent or deliberately prepared fortifications, on the other hand, natural facilities for obstruction are often entirely replaced by artificial obstacles. These are planned and constructed at leisure, so as to give the defender the fullest measure of benefit from them under all foreseen conditions.

2. Use of Obstacles.—(i) Obstacles are used to obtain a definite control, both as regards direction and speed, over the progress of troops advancing to the attack. Their chief value lies in their power to deflect the attacking troops into areas most favourable for their destruction by the defenders.

(ii) There are three objects which must be kept in mind, therefore, in arranging a system of artificial obstacles:

(*a*) They should break up the unity of action and cohesion of the attacking troops.

(*b*) They should tend to deflect the parties thus isolated into the best-swept fields of fire.

(*c*) They should finally arrest the attackers under the close fire of the defender.

Note.—(*a*) and (*b*) may be classified as *Deflecting Obstacles*, (*c*) as *Barrier Obstacles*. Obstacles are especially useful against night attacks.

3. General Rules regarding Obstacles. — The first point to bear in mind when commencing to provide an artificial obstacle or a system of obstacles is that its final and chief value as a barrier will be put to the test when circumstances are unfavourable to the defenders. These unfavourable circumstances are—(*a*) darkness; (*b*) great inferiority in numbers; or (*c*) inferiority of fire.

4. Deflecting Obstacles.—Deflecting obstacles may be at any distance from the firing-points, but if not under fire greater labour and time will be required in order that they may effect their object. It is usual, accordingly, to concentrate efforts upon making the *natural* obstacles on the foreground act as isolating and deflecting obstacles, with slight additions and artificial improvements.

5. Barrier Obstacles.—(i) Barrier obstacles should be under fire *throughout every yard of their length*, and within close range of the defenders. In practice no portion of an

obstacle should be farther than 100 yards from the fire which commands it at night. If obstacles are too close, it may be possible to throw grenades from them into the works.

(ii) Barrier obstacles should be as wide as time and material will allow, should afford the enemy no cover, and should, if possible, be sheltered from his artillery fire. Their actual position will generally be determined by placing them where they can be covered by the most effective fire of the defenders by day and night. It must be remembered, also, that the enemy would usually adopt different lines of advance at night. The tendency would be for them to make use of the easier and better-defined tracks, paths, roads, etc.

(iii) Though a barrier obstacle can never be too strong, it is neither economical nor necessary to make it of equal strength throughout its length. *It should be strongest at those points which are under the least effective fire control.* As a rule it is better first to continue the obstacle in some form completely along the frontage selected as the site of a barrier obstacle, even though it be but the erection of a single wire, than to make one or two short pieces of extremely strong obstacle in places, leaving the rest of the frontage without any obstacle. An exception may be made in favour of any point at which the absence of a strong obstacle may make a whole group of firing-points untenable, provided the importance of these points has been properly assessed and every effort has been made to command them by fire.

(iv) The obstacle should be difficult to remove, to crawl or cut through, or to climb over, without the use of some additional appliances not usually carried on the person of the attackers' infantry, such as ladders, axes, wire-cutters, explosives, crowbars, grapnel hooks, rope, planks, poles, etc. This implies strong material, well secured and un-

crossable by any single individual without artificial assistance.

(v) *Obstacles must not betray the firing-points, and must be concealed.* The exact nature, and, if possible, the existence, position, and extent, of a length of obstacle should not be recognizable by the enemy from a distance which is beyond effective rifle-fire—say, 1,400 yards or over. It should also be impossible for the enemy to locate the exact position of the concealed positions which command the various lengths of obstacle. All important obstacles should be protected from close reconnaissance or sudden local damage by a light guard-fence sufficiently strong and distant to demand extraordinary courage on the part of small parties to cross it, because in doing so they would find themselves between two fences if discovered in the act of examining the main obstacle, and in trying to retreat they could be driven away from the gap or place at which they crossed the guard-fence.

(vi) The concealment of obstacles follows the same rules as for the concealment of other measures of defence. Of the various alternatives usually practicable, disguise is the most efficient. If the obstacle is sunk below-ground in an artificial ditch or cutting, enormous labour will be required to remove or conceal the mass of new earth to be excavated, and this method is seldom suitable for field warfare. It is often possible, however, to take advantage of existing natural cover, such as sunken roads, railway-cuttings, or folds in the ground, for the concealment of portions of obstacles.

(vii) They should not be constructed without authority from the officer commanding the section of the defence, otherwise they may interfere with an advance or counter-attack.

(viii) It is therefore advisable that the position, nature, and extent, of all obstacles should be authorized before con-

struction by the commander of the defending forces detailed for local mobile action, as distinct from those detailed for the occupation of fixed firing-points. This commander may often be the officer in command of all the troops concerned in operations in a certain section or zone of resistance, but it is of the utmost importance that the movement of his mobile forces should not be hindered or prejudiced by the presence of obstacles, or, indeed, by the existence of any purely defensive works whatsoever. It is therefore clearly necessary that he should know exactly what has been done to restrict movement across the area of ground in question, not only in order to arrange his lines of advance for manœuvre or attack, but so that he can turn the presence of obstacles to the advantage of his mobile troops as well as to that of his troops acting on the defensive whose counter-attack must not be impeded by obstacles.

(ix) Thus it follows that an artificial obstacle should not run in an unbroken line across ground suitable for manœuvre by the mobile forces of the defence. This does not mean that relatively small areas such as closed groups of firing-points, redoubts, or similar "defensible islands," should not be entirely enclosed by obstacles, for every effort should be made to render such points true "holdfasts" and reliable pivots for manœuvre under all conditions, and without a continuous ring of obstacle they could not be considered truly proof against assault.

(x) Another reason why troops acting on the defensive on prepared ground should not erect a continuous fence between themselves and the enemy is that by leaving considerable gaps at frequent intervals they are able to influence the lines of advance taken by the enemy. There is a universal tendency amongst attacking troops to adopt the lines of least apparent resistence when advancing, and they will seldom cross an obstacle if there appears to be an easier way round.

Section 33.—Various Obstacles employed in the Field.

1. The exact nature of the obstacle itself will depend to a great extent upon the materials obtainable, and the time and labour available for construction. The following list contains obstacles which are partly natural and partly artificial.

(i) **Ditches.**—Wet and dry, artificially deepened or widened to increase the difficulty of crossing them. In the case of a ditch made or used as an obstacle, it may be considered impassable by unassisted individuals carrying arms if it is at least 15 feet wide and 10 feet deep, with vertical or very steep sides.

(ii) **Scarps.**—Steep banks and cliffs, improved by scarping or steepening a portion until it is unclimbable.

(iii) **Hedges.**—Hedges, improved by interlacing them with wire until they are practically impassable till cut down.

(iv) **Trees.**—Growing trees, used as fencing-posts, and formed into wire fences or wire entanglements.

(v) **Heavy Abatis.**—Large trees felled side by side, and the branches used to support wires closely interlaced.

(vi) **Tree Entanglements.**—Smaller trees cut nearly through at a height of 3 or 4 feet above ground, the branches forced down to the ground *towards* the enemy, and securely pegged down. The stumps used as posts for a strong wire fence, and the branches interlaced with wire *until a man cannot crawl under or climb over.* Several rows may be formed with advantage. A typical site would be the edge of a wood, orchard, jungle, etc.

(vii) **Light Abatis.**—Branches cut off trees and crowded in a row side by side and heaped up, *with the stump ends away from the enemy,* and very securely anchored down to the ground or buried. Each stump to be anchored singly, so that a bursting shell, a local explosion, or an attempt to drag a portion away, will not form a large gap. The

length and number of the branches is far more important than their size, and they should be well packed up with prickly small stuff such as holly, thorn, and briars, and interlaced with wire, as above. After completing one good row, other rows can be added behind the first, and well crowded up to it. At least three to six rows are required to make a formidable obstacle.

(viii) **Note.**—All the above obstacles will be much improved if strewn liberally with *broken glass and bottles* collected from any adjacent buildings, special attention being given to the front edge and immediate foreground of the obstacle, and in hollows, etc., where scouts may attempt to crawl up and reconnoitre, cut wires, or set fire to abatis, etc.

Fish-hooks also of every size should be collected wherever obtainable, and fixed so as to dangle about 6 inches above the ground.

Section 34.—Inundations.

1. (i) A useful obstacle can be made occasionally either (*a*) by raising the level of the water in a shallow stream until it becomes unfordable, or (*b*) by diverting water from a confined channel, so that it floods a larger area of surrounding land. In case (*a*), to be effective, the depth of water should be at least 6 feet. The labour entailed is usually so great that unless the situation is extremely favourable it may be found better to devote the time to the construction of some other form of obstacle.

(ii) An inundation obstacle need not necessarily run parallel to the general firing-line of the defence. It may also have great value as a deflecting obstacle when it runs perpendicular to the general defensive frontage.

2. Raising Level of Water.—(i) Favourable circumstances for inundation by raising the level of water occur when a stream already flows at a suitable spot through a

masonry structure such as an archway or culvert, a water-mill with sluices, or between hard and steep banks at a point where the stream is much contracted from its normal width, and cannot be seized or heavily shelled by the enemy. The waterway may then be blocked with earth, etc., arranged to form a dam. The earth may be thrown in loose or, better, built up in sacks, but in either case arrangements must be made in advance to deal with the eventual overflow of the water, which should not be allowed to overtop the dam itself.

(ii) An overflow-channel should be dug in the solid ground clear of one or both ends of the dam, and so arranged that the water will overflow before it arrives in height within 2 feet of the top of the earth dam. The channel area of the overflow should slightly exceed that of the full stream. To prevent the water from rising too quickly and over-topping the dam during construction, work should proceed from both banks out towards the centre, where a gap is left open till the last moment. Into the bottom of this gap should be driven plenty of stout stakes to help to retain the material when finally thrown in to close the gap. This material should be heaped up on the brink of the gap on each side, should be in sacks, if possible, and a special muster of hands made to throw it in with the greatest speed at the last.

(iii) For a temporary dam of this description it is important to have a very gentle slope on the up-stream face of the dam not steeper than 1 in 3. The back of the dam, or down-stream face, may be left at the natural angle of repose of the soil, or, if built up with bags or sacks, at a slope of 1 in 1. The thickness of the dam at the top should not be less than its height above the bed of the stream. The value of a water obstacle of this description may be increased by obstructing the bed of the stream with a wire fence, etc., before raising the water by damming it.

3. Diverting Water.—Inundation by diverting water requires little description. Where the water is already running in a confined channel above the general level of the surrounding country, a cut through the bank is all that is necessary to produce the required inundation; or, if it is required to preserve the banks intact, the water can be dammed as in (*a*) until it overflows the banks at points selected and prepared to resist erosion.

Section 35.—Wire Fences.

1. Obstacles constructed artificially and upon alignments which may be quite independent of assistance from existing cover or natural features of ground must next be considered. These are practically the universal modern form of artificial obstacle used on the battle-field. A wire-fence obstacle (Fig. 76) may consist of anything from a single strand of wire arranged to trip a man in the dark, or in long grass, etc., to a "150 strand" wire entanglement 30 feet or more in width.

2. Materials.—The materials required are wire and stout stakes, or iron or steel fencing-posts, which now abound in every iron-working country, and are less visible from a distance. As the available wire is usually limited in quantity, it is always laid down by the commander who orders the obstacle to be made how much wire is to be used—namely, how many yards of wire are to be used to the yard run of frontage occupied by the finished obstacle. This, as mentioned above, may require between 100 and 150 yards of wire to the yard of frontage to be covered, in order to make a first-class obstacle.

3. Note to Fig. 76.—The chief aim and essential condition of success in wiring is to produce an obstacle *which cannot be crawled through at or near ground-level.*

The top wires must be *irregular and slanting*, so that

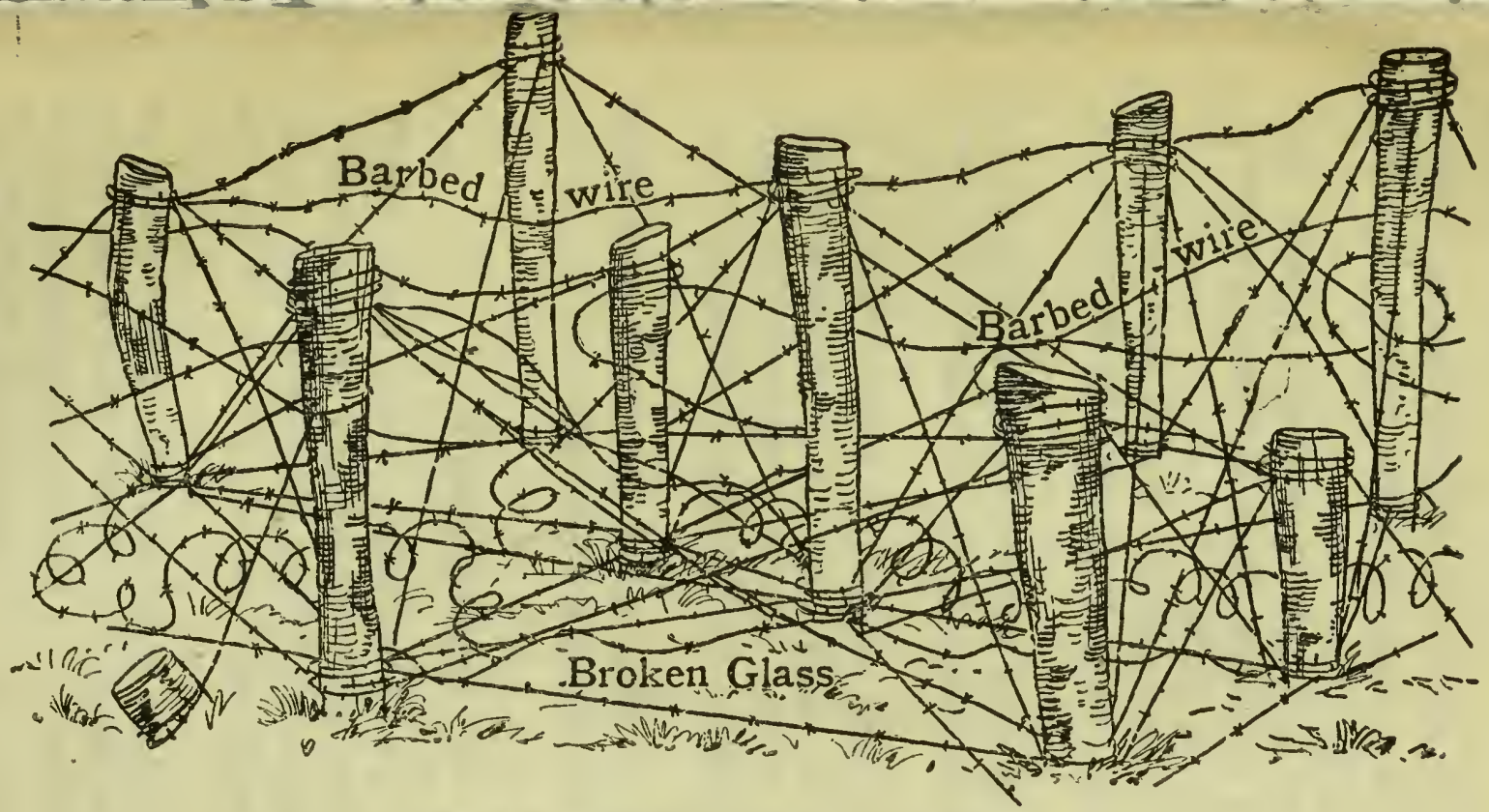


Fig. 76.—WIRE ENTANGLEMENT.

Posts.—All heights up to 6 feet out of the ground. Material: wood, 5 to 6 inches diameter, or steel posts* of any kind. Should be coloured to harmonize with surroundings before wiring begins. Spaced irregularly —average, 5 to 8 feet apart. Very firmly driven, and anchored by side-stays. Total width :—See Section 32 (5) ii.

Wire.—All kinds, including one or two very strong cables or chains, if available. Preferably barbed, and the thicker the better. The thickest wires next the enemy. The wire should not remain brightly galvanized, but be dulled or passed through paint before use. All wires well stapled and secured to the posts at varying heights.

Add dangling fish-hooks if available.

* A minor objection to steel posts, which applies also to all forms of steel fencing, is that they intercept and deflect a proportion of the defenders' bullets, which would pass freely through wooden posts.

planks, ladders, etc., will tip over if an attempt is made to climb over the top.

The ground on the enemy's side and within the entanglement should be well strewn with broken glass, bottles, odds and ends of tangled wire, etc.

Every part of the entanglement must be under fire from firing-points definitely selected with a view to perfect control of the entanglement at night.

These firing-points may be entirely protected and screened from frontal fire, and devoted only to sweeping the front of the entanglements at night.

The width and density of the entanglement should be greatest where the fire of the defence will be least effective by night.

One man cannot be expected to watch more than 60 or 70 yards of entanglement at night, or to be aware of an attempt to cut the wires, etc., unless assisted by good alarm-signal wires. Systematic patrolling is necessary to detect such attempts early.

The whole obstacle must be concealed by every available means from the view of the enemy's artillery.

Section 36.—Alarm-Signals.

1. Double Action.—To be effective, the wire must work the alarm-signal either if it is pulled or blundered into, or if it is deliberately cut. The simplest and most effective improvised arrangement is shown in Figs. 77 and 78.

2. Main-Signal Wire.—(i) The main-signal or line wire is securely anchored to an immovable object at its far end, and at the near end is fastened to a stake or picket, which has some appreciable spring in it. It should be capable of adjustment as regards tightness, etc., by means of a guy-cord (see Fig. 77). This main-signal wire must be supported at

suitable intervals at a height of about 18 inches above the ground. It must run freely through the wire loops on the pickets or other means by which it is supported, and should, if possible, run straight without change of direction, and over ground as level as possible.

(ii) If the signal wire runs over very uneven ground, it will tend to lift its supporting pickets out of the ground at hollows, and to bear down with much friction upon those pickets which stand on lumps or convex ground. Both these factors impede the free action of the wire, but will not as a rule prevent the alarm from acting if care is taken. With a straight and level run for the wire good results have been obtained up to 1,000 yards, but each signal wire must be adjusted and tested on its merits.

3. Alarm Action.—(i) The alarm action is as follows: A single stout picket—the *end-post*—is driven firmly into the ground about 2 to 3 feet from the *spring-post*, and stands alone and apart from the apparatus. It should be sawn off clean at the same height as the spring-post, which should also have a clean sawn top. A light flat stick or batten long enough to rest on the heads of both spring-post and end-post, with, say, a foot of length to spare, is weighted with a brick or stone or similar weight, as shown (Fig. 77), and rests quite loose upon the heads of the two posts.

(ii) When this weighted stick is dislodged, it must pull the alarm-signal during its fall to earth. The alarm-signal itself is pulled by means of the alarm-string, which is fastened to the weight-stick as shown, and passes loosely through a hole or staple near the top of the spring-post. The alarm-string has a stop fixed in it (a small wooden toggle, piece of stick, etc.) on the side of the spring-post nearest the weight-stick.

4. Setting Alarm for Action.—(i) The setting of the alarm for action is done as follows: The main line wire is set out, supported, and drawn tight by means of the adjusting guy

until there is a good spring in the spring-post. The weight-stick is rested by hand on the top of both posts, so that it *only just engages the top of the spring-post*, but rests fairly on the end-post. If any more tension is put in the line wire, by design or accident, the weight-stick will fall off the spring-post and pull the alarm-string leading to the signal.

(ii) Again, if any tension is taken off the line wire, as would happen if it was cut, the spring-post will give up some of its spring, and in flying back will pull the same

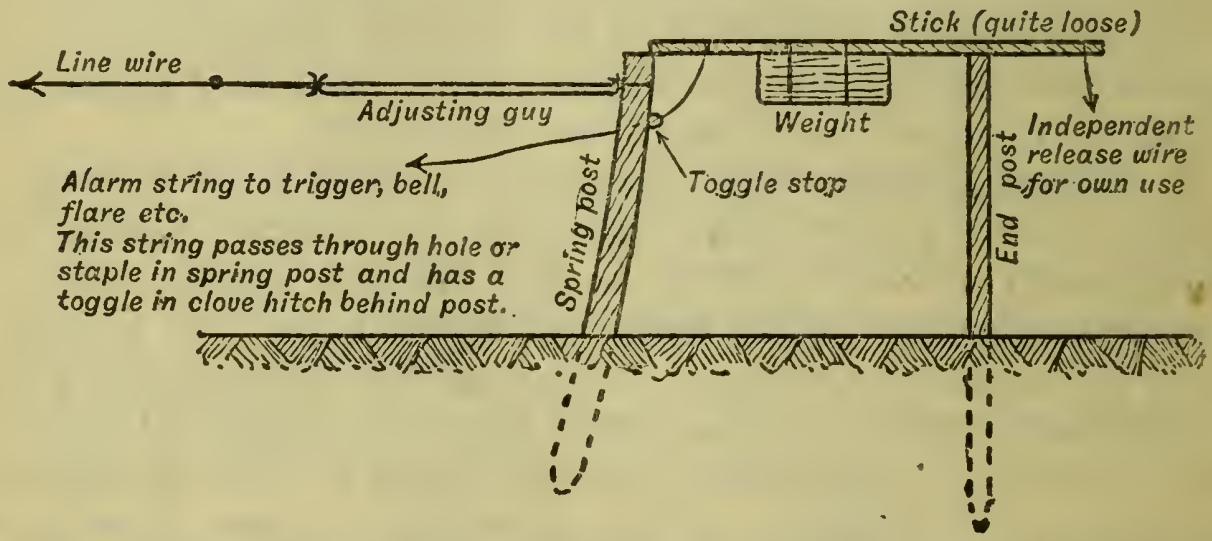
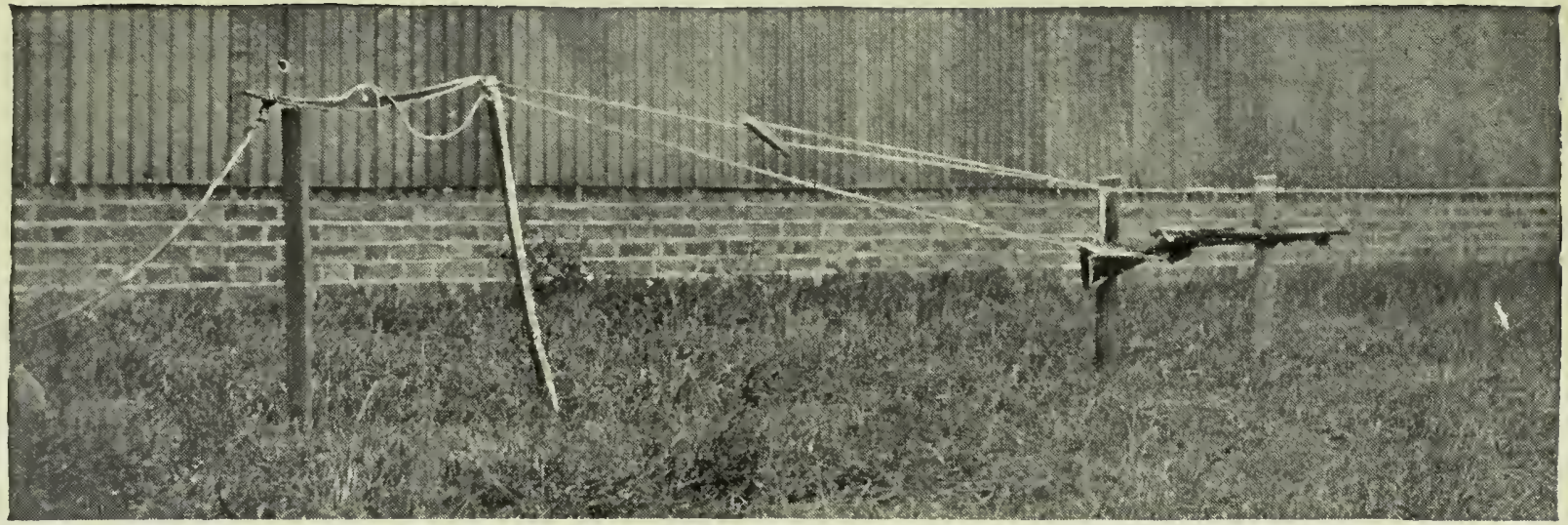


Fig. 77.—METHOD OF SETTING ALARM-WIRE TO ACT, WHETHER CUT OR PULLED.

alarm-string by means of the stop or toggle (see Fig. 77). Also, should the defenders wish to operate the alarm-signal at any time, the weight-stick can be pulled off its supports by means of an independent string attached to it anywhere, and pulled by hand from a lookout post, etc., at any reasonable distance away.

5. General Information.—(i) **Slackening Wire.**—The alarm-wire will usually be slacked off by day, and only set for night use. It must be remembered that a change to colder temperature will shorten the length of a long wire, and



Pickhead as falling weight. Rifle as signal.

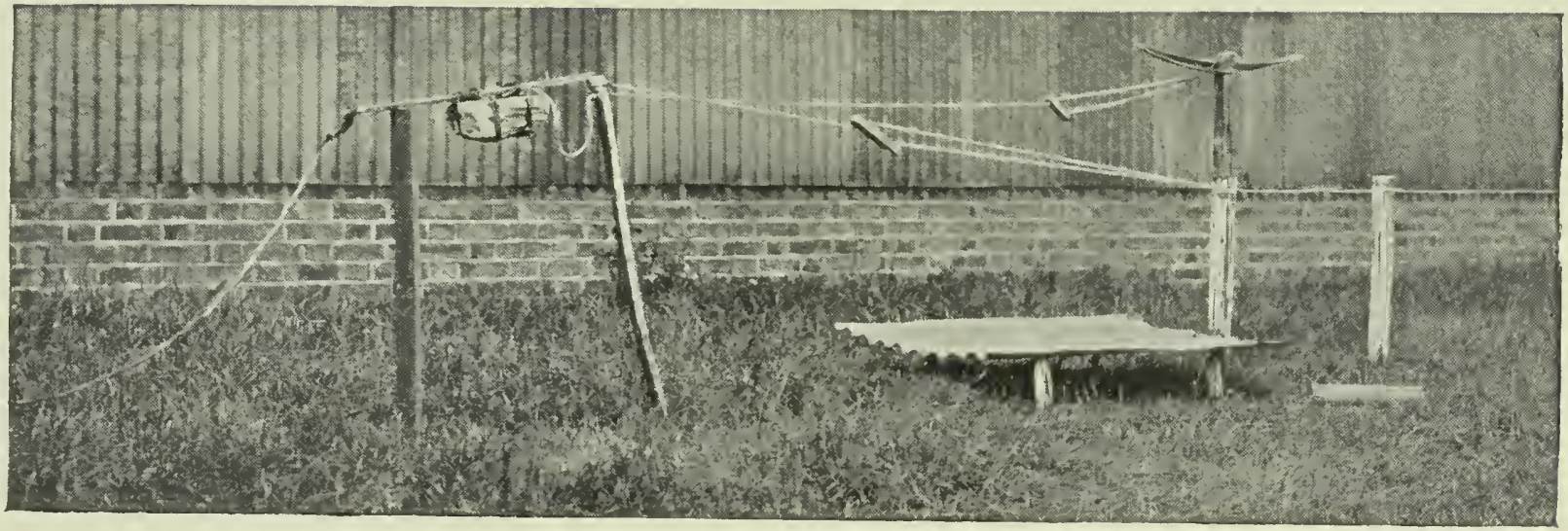


Fig. 78.—ALARM SIGNALS.

Weighted stick as falling weight. Pickhead and sheet-iron signal.

To face p. 184.

that wet weather also will tighten the cord of the adjusting guy, so that the weight-stick should not be set too fine on the spring-post.

(ii) **Line Wire.**—The line wire may be plain light soft-iron wire about 16 gauge, or stronger for distances over 300 yards. It must have no kinks or weak spots in it. For fairly short distances the stoutest salmon-line is suitable, or tarpon-line, if obtainable.

(iii) **The Spring-Post.**—A cart-spring or iron-fencing bar can be used as an alternative to a green stake. *Sawn deal is quite unsuitable.*

(iv) **The End-Post.**—Anything really firm will do for the end-post. It must not wobble at the top, or the weight-stick may adhere to and move with the spring-post without falling when the line-wire is run into.

(v) **The Weight-Stick.**—This may equally well be the steel head of a pickaxe, an iron bar, etc. (see Fig. 78). It must have sufficient height in its fall to take up all the slack in the alarm-string, and must be set so that it does not catch on the toggle stop, and get held up just as it begins to fall when released.

(vi) **The Alarm-Signal.**—A single rifle-shot is a poor alarm-signal, because occasional rifle-shots attract little attention under the circumstances in which the signal is likely to be of use. A double shot-gun, however, would make a distinctive noise if both triggers are pulled. A pick-head or stone falling on to an iron tray or piece of corrugated sheeting supported as a drum above ground (Fig. 78) makes a distinctive noise, but is not heard very far away. A cycle bell which only rings once when pulled is not quite distinctive enough.

Electric bells, etc., cannot be trusted after exposure to bad weather. Whatever form of signal is adopted, it should not be liable to injury when violently jerked by the alarm-string, and should be easy to reset. If a service

rifle is used, and is not to be damaged, the pull should be communicated to the trigger by means of a thin string which would snap before injuring the trigger, or by means of a stout rubber band or ring.

6. Caution.—*No mechanical signal must be relied upon as a substitute for the efficient use of the eyesight and hearing.*

Section 37.—Trip-Wires, Rattles, Flares.

1. Trip-Wires and Rattles.—Plain, low, fixed, straight, or coiled wires are sometimes usefully placed in front of firing-points with the object of flinging individuals to the ground in such a manner as to betray their presence. Their limitations are obvious. Young troops are often also fond of hanging tins, etc., containing a pebble and similar devices on to wire fences or entanglements in order to hear when the fence is being tampered with in the dark. To be effective, these rattles must be sensitive and well arranged. If sensitive, they respond to every gust of wind and rain, and may give rise to continual false alarms.

2. Flares to Illuminate Foreground at Night.—(i) These require special stores to light them. They also require great skill to set them, so that they will survive a deluge of rain, and still light up when required.

(ii) Good flares can be improvised if magnesium torches are available. Ignition can be arranged by means of a long narrow strip of strong rough sand-cloth, which is placed next to a number of non-safety match-heads embedded in the mouth of the torch, and jerked by a string or wire from a distance. Given time to prepare them, any fireworks-maker can supply torch-flares which can be ignited from a distance, and which will survive a good deal of wet weather.

(iii) A good type of field light can be made with a torch-flare and tin reflector so designed that, until required to

burn, the reflector acts as an umbrella to the torch as it hangs mouth downwards. When the release-line is pulled, the torch flies up to a horizontal position by means of a spring, and is lit in the process.

(iv) A powerful acetylene lamp burning in a small pit, and so arranged that it can be pulled up to shine above ground-level and be lowered again into the pit at will, is amongst the best of these devices.

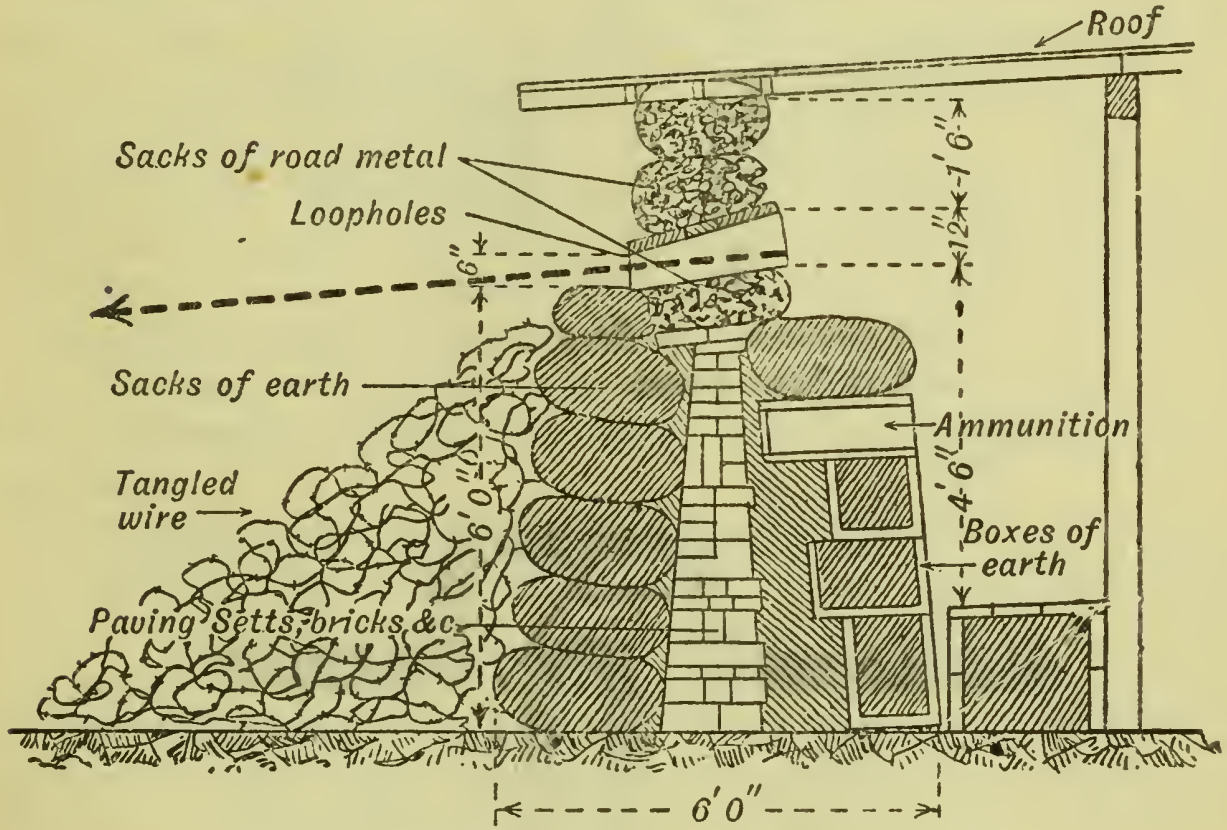
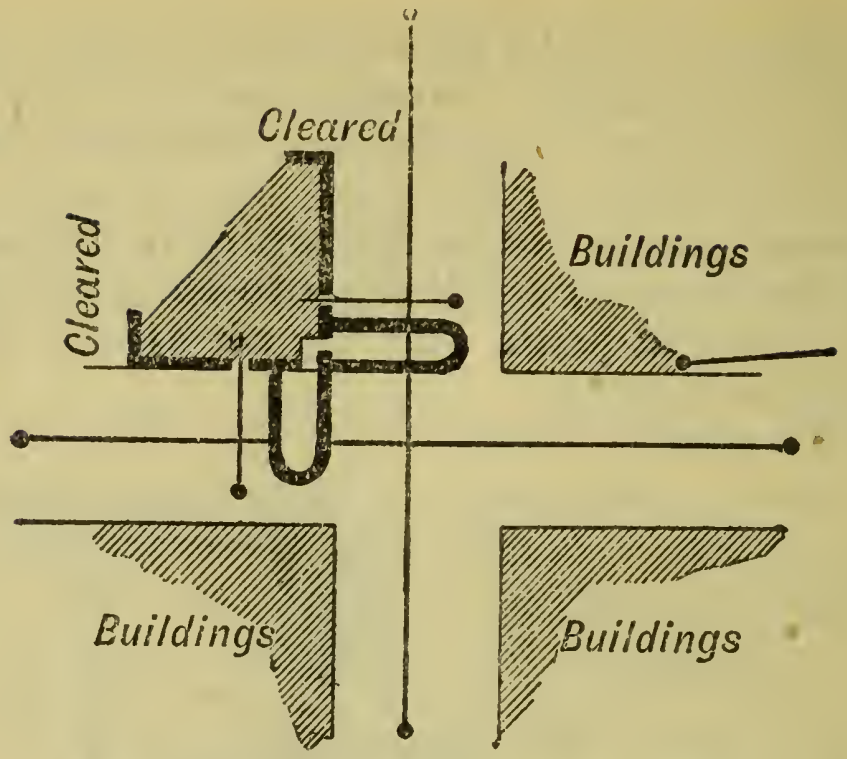


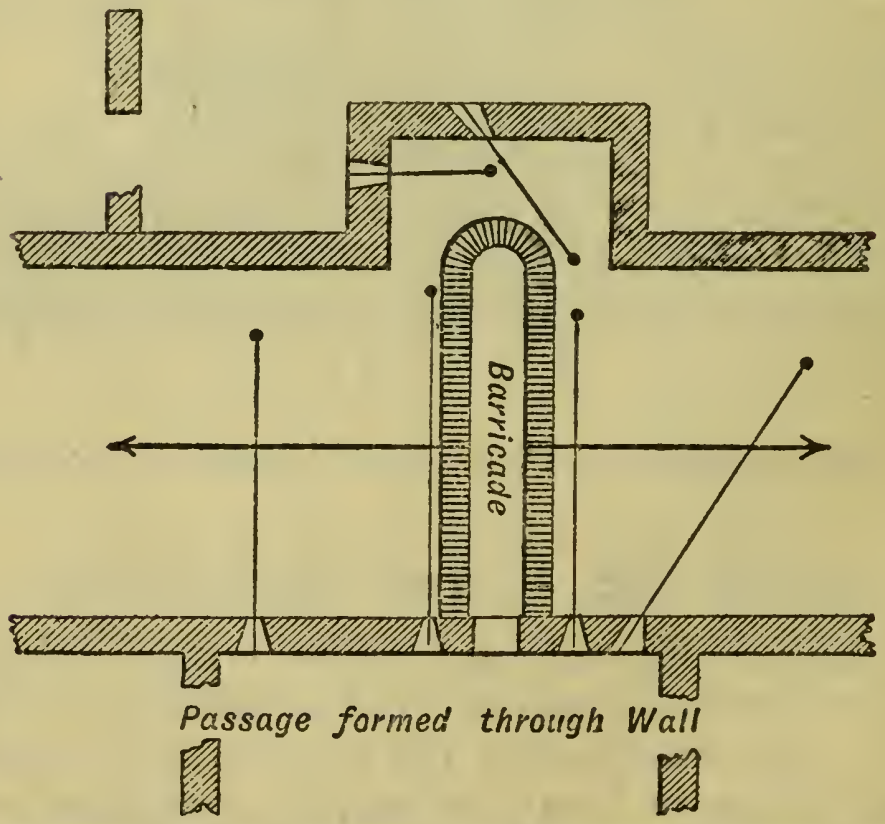
Fig. 79.—OBSTRUCTION: DEFENSIVE STREET BARRICADES.

Section **38.**—Street Barricades.

1. Barricades to fire along streets, roads, bridges, etc., can be made of almost any materials available. They should not as a rule completely close the road to traffic, but should be arranged either in two overlapping portions, with way between for wheeled traffic, or be placed where a house or



Arrangement of Street Stockades to fire four ways.



Figs. 80 AND 81.—DEFENSIVE STREET BARRICADES.

courtyard giving space back from the general line of buildings allows a passage round one end of the barricade (Fig. 81).

2. For firing four ways, they should be arranged as shown in Fig. 80, the construction being similar to two fronts of Fig. 79, arranged back to back. Care should be taken to render adjacent corner houses useless to an enemy for firing into the barricades.

3. Fig. 79 set out on a circular plan will form a good block-house. To hold ten riflemen, an inside diameter at ground-level of about 10 feet will give a diameter of 13 feet at loophole-level, and a perimeter of about 40 feet. This will allow for loopholes 4 feet apart. The entrance should either be a small tunnel at ground-level, passable only on all fours, or sunk below ground, and coming up under a cellar-flap inside.

4. Caution.—*It is no use constructing barricades of the above description where they will come under direct fire from artillery.*

5. Passage of Obstacles.—It must be decided whether the obstacle is to be passed by (*a*) cutting through, (*b*) bridging over, or (*c*) tunnelling under. Whichever plan is selected, careful reconnaissance of the actual sites selected for passage must precede the operations. These should be simple, but carried through silently and with determination, and should as a rule take place in darkness and as a surprise. Explosives lashed to a light pole and resting on the top of wires in an entanglement will cut all wires in contact, and a few others.

"Runaway" motor-cars at full speed may assist under favourable conditions. Steel grapnel-hooks placed by one man and hauled on by many from a distance will assist after a few wires have been cut.

Gangways for bridging over should be at least 2 feet wide.

APPENDIX

I. DEFINITIONS AND TECHNICAL TERMS CONNECTED WITH ENTRENCHMENTS

Abatis.—An obstacle formed of trees or branches of trees picketed to the ground, with their points towards the enemy.

Banquette.—The place upon which men stand to fire over a parapet.

Batter.—The slope of the face of any stone or masonry structure which is not vertical.

Berm.—A small space left between the parapet and excavations of a work.

Caponier.—A small chamber formed in the ditch of a work and projecting from the escarp to give fire along the bottom of the ditch.

Casemate.—A shell-proof chamber constructed for the accommodation of the garrison of a work or position.

Choke.—The mouth of a sand-bag when closed and secured.

Command.—The vertical height of the crest of a work above the natural surface of the ground, or above the crest of another work.

Counterscarp.—The side of the ditch of a work farthest from the parapet.

Cover.—Concealment from view or protection from fire, or a combination of both.

Crest.—The intersection of the interior and superior slopes of a parapet.

Dead Ground.—Ground which cannot be covered by fire.

Defilade.—The adjustment of the levels of the crest and interior portions of a work with a view to obtain cover for the defenders or to screen them from view.

Detonator.—A small charge of fulminating explosive used to apply the pressure and temperature necessary to detonate a larger charge of explosive.

Ditch.—An excavation which is not intended for occupation. It serves as a source of supply of earth for the parapet, an obstacle to assault, or a means of drainage.

Enfilade Fire.—Fire the line of which sweeps a target from a flank.

Escarp.—The side of a ditch nearest the parapet.

Exterior Slope.—The outside slope of a parapet extending downwards from the superior slope.

Fascine.—A long bundle of brushwood, tied up tightly, used for roadmaking, etc.

Field of Fire.—Any area of ground exposed to the fire of a given body of troops or group of guns.

Flèche or Redan.—A work consisting of two faces, forming a salient angle towards the enemy.

Foreground.—That portion of a field of fire lying nearest the origin of the fire.

Frontal Fire.—Fire, the line of which is perpendicular to the front of the target.

Gabion.—An open cylinder of brushwood, sheet-iron, etc., used for revetting.

Glacis.—The ground round a work within close rifle range. It is sometimes formed artificially.

Gorge.—The face of a work least prepared to receive frontal fire.

Gradient.—A slope represented by a fraction—*e.g.*, $\frac{1}{30}$ represents a rise or fall of one unit measured vertically for every 30 units measured horizontally.

Grazing Fire.—Fire which is parallel, or nearly so, to the surface of the ground.

Head-Cover.—Cover against frontal or oblique fire for the heads of men when firing.

Headers.—The term applied to sods, sand-bags, etc., placed so that their longest side is at right angles to the face of the structure in which they are being used.

Helve.—The handle of an axe or pick-axe.

High-Angle Fire.—Fire from all guns and howitzers at angles of elevation exceeding 25°.

Interior Slope.—The inner slope of a parapet extending from the crest to the banquette.

Keep or Réduit.—A separate enclosure within another work to enable the defenders to bring fire to bear upon a field of fire lying within the outer line of defence.

Lunette.—A work consisting of four faces, the two centre ones forming an obtuse salient, the two side ones affording fire to the flanks.

Lunette, Blunted.—A work consisting of five faces (otherwise similar to a lunette).

Machicoulis Gallery.—A balcony with a bullet-proof floor and parapet; loopholed in the floor to afford fire in a downward direction.

Oblique Fire.—Fire the line of which is inclined to the front of the target.

Overhead Cover.—Cover against projectiles whose steep angle of descent would otherwise enable them to strike the target.

Palisades.—Palings intended to resist the passage of troops.

Parados.—A traverse to give cover from reverse fire.

Pickets.—Posts sharpened at one end for driving into the ground by hand-power.

Plunging Fire.—Fire when the target is much below the gun, so that the projectile strikes the ground at a steep angle of descent.

Primer.—A small piece of dry guncotton used to detonate wet guncotton.

Profile.—The outline of the section of a parapet at right angles to the crest.

Redan, Blunted.—A work consisting of three faces, the centre one firing to the front, the others to the flanks.

Redoubt.—A field-work entirely enclosed by a defensible parapet, which gives rifle-fire all round. It may be of any command.

Relief.—The length of time that men have to work before being relieved, or a party of men who work, or who are on duty, for a given length of time.

Retrenchment.—A work or works arranged so as to form a second, but not necessarily separate, line of defence, and also usually to reduce the area to be covered with fire.

Reverse Fire.—Fire which is directed against the rear of a target.

Revetment.—Any material formed into a retaining wall to support earth at a steeper slope than that at which it would naturally stand.

Sangar.—A dry-built stone wall to give protection against rifle-fire.

Sap.—A trench formed by men working from the bottom of the trench and constantly extending the end towards the enemy.

Searching Power.—The power of a projectile to reach an objective behind cover. It varies with the description of weapon, the range and the angle of descent of the projectile.

Spit-Lock.—To mark out a line on the ground with the point of a pick.

Splinter-Proof.—A shelter proof against splinters of shell.

Storm-Proof Work.—A work is considered storm-proof when its design is such that, no matter how great the determination of the assailants may be, they can be destroyed as fast as they can advance to the attack.

Stretchers.—The term applied to sods, sand-bags, etc., placed so that their longest side is parallel to the face of the structure in which they are being used.

Superior Slope.—The top of a parapet immediately forward from the crest.

Task.—The amount of work to be executed by a man during a relief.

Terreplein.—The surface of the ground inside a work.

Trace.—The outline of a work in plan.

Traverse.—A bank of earth erected to give cover against enfilade fire, and to localize the bursts of shells.

Trench.—An excavation which is for use either as a means of concealment, or protection, or both.

II. EFFECT OF WEAPONS ON FIELD-WORKS

1. In order that field-works may be designed to the best advantage, the effect of rifle and gun fire at various ranges should be fully realized.

2. **Rifle-Fire.**—Modern military rifles are sighted to about 2,800 yards. Their maximum range may be taken as about 3,700 yards. The slope of descent of the bullet varies from about $\frac{1}{11}$ at 600 yards and $\frac{1}{5}$ at 1,100 yards, to $1.\frac{1}{3}$ at 2,200 yards.

3. The heights over which an average man can fire on level ground as adopted in various armies, are—

	France.	Germany.	Russia.	Great Britain.
Lying down	—	11·8 in.	—	1 ft.
Kneeling ...	3 ft. 3·3 in.	2 ft. 11·4 in.	2 ft. 10·8 in.	3 ft.
Standing ...	4 ft. 7·1 in.	4 ft. 7·1 in.	4 ft. 8·0 in.	4 ft. 6 in.

On level ground a man can fire over about five-sixths of his own height.

A higher parapet can be used when firing up-hill than down-hill.

4. **Penetration of Rifle Bullet.**—The table on p. 195 gives the maximum penetration of the pointed bullet in various materials.

In order to obtain proof cover, a percentage must be added to these numbers—*e.g.*, earth parapets should not be less than 3½ feet thick. If the soil is free from stones, a thickness of 4 feet is desirable. The length of the service rifle is 3 ft. 8½ in.

5. **Artillery Fire.**—The aim of field artillery in the attack of a position is to assist the advance of its own infantry by bursting its shrapnel in such a position that the defenders will either be forced to keep under cover or be struck. No attempt is made to breach the parapets of infantry fire trenches.

An occasional shell may strike and penetrate the parapet, but in the case of shrapnel the damage to the parapet will be trifling, while in the case of a shell filled with high explosive the effect will be no worse on a thin parapet than on a thick one. It is therefore useless to spend time and labour on making a thick parapet simply to keep out shell.

6. **Field Guns.**—Both shrapnel shell and high-explosive shell are fired by the field artillery of most foreign nations. *Shrapnel* with time fuses can be used up to a range of about 6,000 yards. With percussion fuses shrapnel can be used effectively against troops behind 14-inch brick or 2 feet thick mud walls, as they penetrate before bursting. *High-explosive shells* are intended for use chiefly against permanent fortifications, or against shielded guns. *The angle of descent* of the projectile varies from $\frac{1}{20}$ at 1,500 yards to $\frac{1}{3}$ at 4,000 yards.

PENETRATION OF RIFLE BULLET.

Material.	Maximum Penetration.	Remarks.
Steel plate, best hard ...	$\frac{7}{16}$ inch	At 30 yards normal to plate; $\frac{3}{16}$ inch is proof at not less than 600 yards, unless the plate is set at a slope of $\frac{1}{2}$, when $\frac{5}{16}$ inch is proof at 250 yards.
Steel plate, ordinary mild or wrought iron	$\frac{3}{4}$ inch	
Shingle	6 inches	Not larger than 1 inch ring gauge.
Coal, hard	9 "	
Brickwork, cement mortar	9 "	150 rounds concentrated on one spot will breach a 9-inch brick wall at 200 yards.
Brickwork, lime mortar	14 "	
Chalk	15 "	
Sand, confined between boards, or in sandbags	18 "	Very high velocity bullets have less penetration in sand at short than at medium ranges.
Sand, loose	30 "	
Hard wood—*e.g.*, oak, with grain	38 "	
Earth, free from stones (unrammed)	40 "	Ramming earth reduces its resisting power.
Soft wood—*e.g.*, fir, with grain	58 "	Penetration of brickwork and timber is less at short than at medium ranges.
Clay	60 "	Varies greatly. This is maximum for greasy clay.
Dry turf or peat ...	80 "	

7. **Field Howitzers** fire both shrapnel shell and high-explosive shell. The chief difference between their fire and that of field guns is that the shell is heavier (varying from 30 to 45 pounds), contains a larger bursting charge, and has a steeper angle of descent. Howitzer fire therefore possesses greater searching power than

that of field guns. They can fire shrapnel shell up to a range of about 6,000 yards, while their extreme range is about 7,000 yards. The angle of descent of the projectile may be as steep as ¼.

8. **Heavy Guns and Heavy Howitzers** fire both shrapnel shell and high-explosive shell of still greater weight at ranges up to 10,000 yards. These pieces are specially useful for long-range enfilading fire, and for smashing permanent fortifications.

9. **Table of Ranges.**—The following is a table of ranges and the terms applied to them :

Terms applied to Ranges.	Rifle.	Field Artillery.	Heavy Field Artillery.
	Yards.	Yards.	Yards.
Distant ...	2,800 to 2,000	6,500 to 5,000	10,000 to 6,500
Long ...	2,000 to 1,400	5,000 to 4,000	6,500 to 5,000
Effective ...	1,400 to 600	4,000 to 2,500	5,000 to 2,500
Close ...	600 and under	2,500 and under	2,500 and under

The extreme range of field artillery using percussion shell may be taken as 9,000 yards, and of heavy artillery as 10,000 yards.

The width of the area of ground struck by the bullets of an effective field gun shrapnel is about 25 yards.

The length of the forward spread of the bullets of field gun shrapnel burst at medium range is about 200 yards.

III. TOOLS AND MATERIALS

Tools and Methods of Use.

1. **Entrenching Tools.**—The service entrenching tools consist of *shovels*, *pickaxes*, *spades*, *crowbars*, and the *entrenching implement*.

(1) **The Shovel** is used right or left handed, and the thigh should be employed to assist in thrusting it under earth which has been loosened. In throwing earth from the shovel there should be no jerk, the hand nearest the blade must be allowed to slide freely up the handle, otherwise the earth will scatter.

(2) **The Pickaxe.**—For safety in trench-work, the pick must be used working front and rear, and never sideways. Before striking

the pick into the ground, it should be raised well above the head with both hands. In bringing it down, the helve should slide through the hand nearest to the head, and full advantage taken of the weight of the pick-head.

(3) **The Entrenching Implement** (usually known as the "grubber"). —In using the entrenching implement, men should be taught to work lying down. The general procedure is described on p. 41.

2. **Cutting Tools.**—The service cutting tools are the *felling axe*, *hand-axe*, *cross-cut saw*, *hand-saw*, *folding saw*, and *bill-hook*. The importance of keeping all cutting tools sharp and firmly handled cannot be exaggerated.

3. **List of Tools, etc.**—The list on p. 198 and Figs. 82 and 85 show different types of entrenching and cutting tools, sand-bags, etc. Figs. 83 and 84 show the entrenching tools carried by the infantry soldier and the manner in which they are worn as part of his equipment.

Materials.

1. **Earth.**—Of all the materials which are most generally available for the construction of field defences, earth is the most valuable, as well as the most common. It is usually procured from trenches or ditches dug as near as possible to the place where it is to be used. The steepest slope at which thrown-up earth will stand is about 45°, or 1. To make it stand at a steeper slope it must be revetted.

2. **Sods.**—Sods are used for revetments, and also to form walls in special cases. They should be cut about 18 inches long, 9 inches broad, and 4½ inches thick. They must not be cut where the resulting scar will betray the existence of the works. Such a scar may sometimes be utilized to represent a dummy trench.

Sod revetment must be laid in alternate layers of headers and stretchers, grass downwards, breaking joint, *and at right angles to the slope*, with two layers of sods in each stretcher course. The top layer should be laid with grass upwards, and all headers. They should be bedded and backed by fine earth well rammed.

3. **Stones.**—Stones may be used to build rough walls in places where digging is difficult or impossible, or other material is lacking. Such walls should be about 2 feet thick at the top, with a batter not steeper than 1 when dry-built. They are undesirable where artillery fire is expected, for the stones are apt to be thrown

KEY TO ENTRENCHING AND CUTTING TOOLS, ETC., ILLUSTRATED IN FIG. 82.

Description.	Approximate Weight.	Length.
	lbs. ozs.	ft. ins.
1. General service shovel	3 8	3 1
2. Ditto side view		
3. Ditto back view		
4. Spade	5 10	3 2
5. Ditto side view		
6. Pickaxe, ferruled helve	8 0	3 0
7. Pickhead, concave side		
8. Ditto convex side		
9. Felling axe	6 7	2 10
10. Hand axe	2 3	1 4
11. Bill-hook	1 13	1 3
12. Reaping-hook	1 0	1 6
13. Cross-cut saw	6 7	5 0
14. Folding saw	1 12	3 9
15. Ditto folded		
16. Ditto case for, with file and set (complete)	—	—
17. Hand-saw	5 6	2 2
18. Wirecutters	1 4	1 0
19. Pliers, side-cutting	—	0 8
20. Crowbar	5 0	26 0
21. Sand-bag, green canvas	0 6	33 ins. × 14 ins.
22. Maul	14 0	2 10½
23. Measuring-rod (3-inch divisions)	—	6 0
24. Sand-bag, filled	60 0	20 ins. × 10 ins. × 5 ins.

Fig. 82.—Types of Entrenching and Cutting Tools, etc.

To face p. 198.

Fig. 83.—Entrenching Implement as Worn in Marchiing Order.

Fig. 84.—Entrenching Implement as Worn in Marching Order.

a, Head of implement in cover ; *b*, helve, attached to bayonet scabbard.

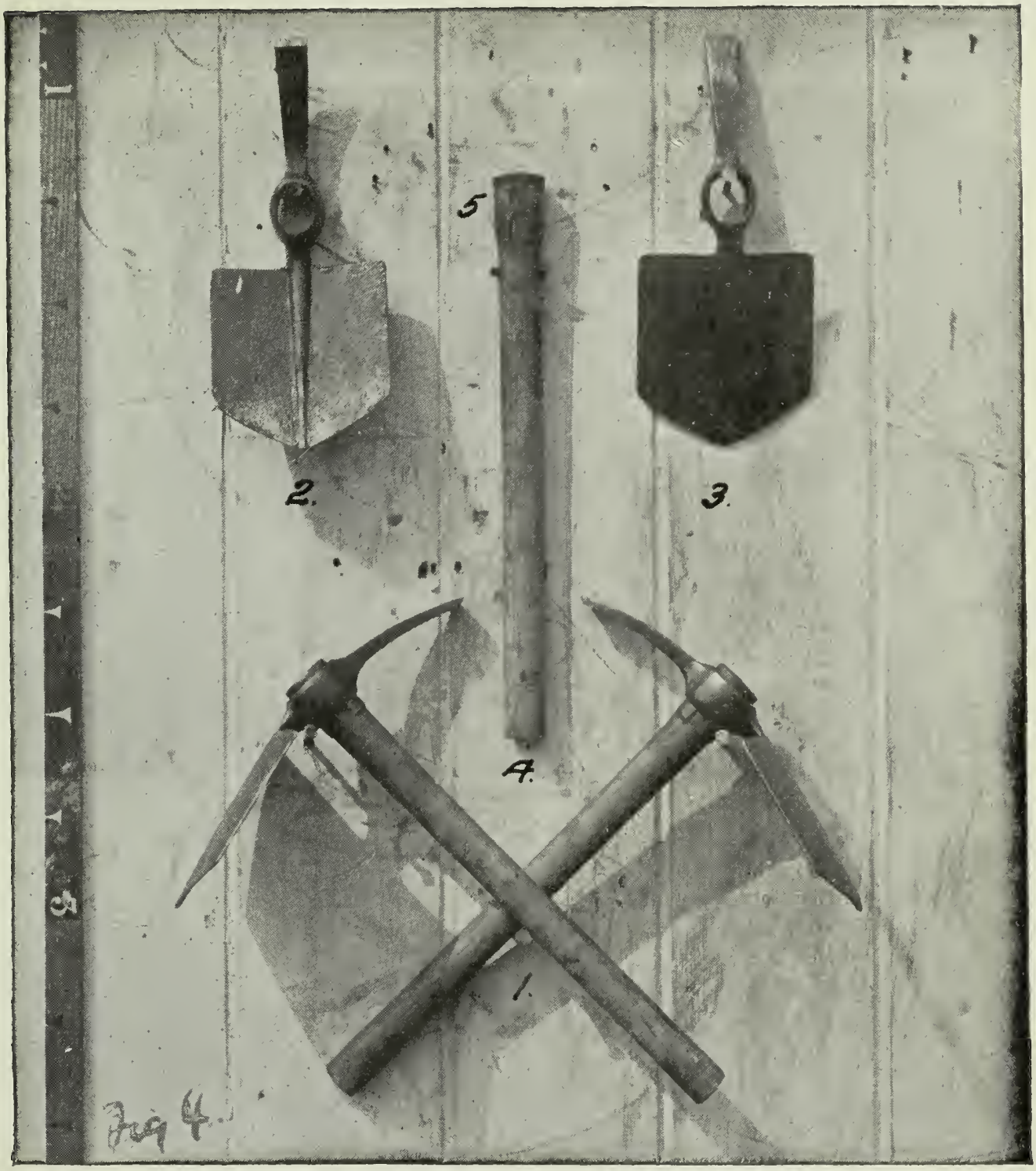


Fig. 85.—ENTRENCHING IMPLEMENT (1 lb. 13 oz.).

1. Two implements complete.
2. Head: concave side.
3. Head: convex side.
4. Helve, with steel ferrule (5), 16½ in. long.

To face p. 198.

about when struck. Only the largest stones which can be handled should be used for such walls.

4. Timber.—Timber is used in the construction of bridges, huts, splinter-proofs, stockades, abatis, etc. The felling axe in the hands of an experienced workman is the best tool for felling timber. The hand-axe is only suitable for felling trees up to 15 inches in diameter. To fell a tree, it should be strained in the required direction of fall by a rope. It is then cut into as far as the centre of that side, and finished off on the opposite side.

If a saw is used for felling timber, the cut must be wedged open to prevent the saw being jammed.

Timber revetment is made by driving strong stakes into the ground, and placing planks or logs between them and the parapet. Planks should never be used for revetments where exposed to the fire of high-explosive shells unless they are secured so firmly that they will break rather than come away whole.

5. Brushwood.—Brushwood is used for road-making, hutting, and revetting. To make a brushwood revetment, stakes are driven into the ground, from 1 to 2 feet apart, along the line of the intended parapet, and anchored back with wire. As the parapet rises, loose brushwood (or ferns, reeds, straw, etc.) is filled in between the stakes and the parapet.

6. Fascines.—A fascine is a long faggot tightly packed and bound, used for drains from trenches, foundations of roads in marshy sites, and occasionally for revetting steps, etc. The usual dimensions are 18 feet long and 9 inches in diameter.

Fascines make a poor revetment by themselves, and their use as a revetment is generally confined to steps. They should be well picketed down.

7. Gabions.—Gabions are cylinders open at both ends, made of almost any material capable of being bent or woven into a cylindrical form, such as brushwood, canvas, expanded metal, wire netting, etc. They form a very stable revetment; but will generally be available in fortress warfare only.

8. Hurdles.—Hurdles, unless for a special object, are usually made 6 feet long and 2 feet 9 inches high in the web. Hurdles are one of the most useful forms of revetment, either in the form of ready-made hurdles, or continuous hurdle revetment constructed simultaneously with the parapet. In either case they should at first be placed at a slope of $\frac{1}{4}$, and frequently anchored into the parapet.

Hurdles are also used in the construction of huts and for temporary roadways.

9. **Sand-Bags.**—The service pattern of sand-bag measures 33 inches × 14 inches empty, is made of canvas and issued in bales of 100, weighing about 40 pounds. When filled with about ⅓ cubic foot of sand, etc., a sand-bag measures over all about 20 inches × 10 inches × 5 inches, and weighs about 60 pounds. Sand-bags are chiefly used for loopholes or for repairing earth-works, etc.

Sand-bag revetment is built with alternate rows of headers and stretchers (the former with the chokes, the latter with the seams, turned into the parapet), breaking joint. The revetment should end with a top course of headers. They should be not more than about three-quarters full, and should be beaten into the required shape when placed in position.

10. **Sacks.**—Sacks or grain-bags, of which an army in the field usually has many thousands available, can be employed instead of sand-bags, and are easy to use. The rules for sand-bag revetments apply also to sacks, except that sacks should not be more than half full and may be laid on all stretchers. It is not necessary to choke or tie up a sack if the mouth is carefully folded under it when it is being placed in position. The weight of the sack will prevent loss of earth. The usual sizes will contain about 2 bushels (2½ cubic feet) of grain, but should only be filled with about 1 cubic foot (say 1 hundredweight) of earth, etc.

11. **Wire.**—Wire is principally used to form an obstacle either alone or in conjunction with abatis, and for lashing spars, etc.

12. **Canvas and Netting.**—Willesden canvas is kept as an article of store, in rolls up to 5 feet wide. For use as a revetment, stout pickets should be driven from 12 inches to 18 inches apart and anchored. The canvas can then be stretched between these and the parapet, and laced with wire to the top and bottom of the pickets. It is useful for making weather-tight all forms of overhead cover and shelters, and for improvising stretchers for the removal of surplus earth from excavations, etc. Wire netting with stakes passed in and out of the meshes and anchored back forms a good revetment in soils which are not too sandy.

IV. WORKING PARTIES AND THEIR TASKS

General Instructions.—1. *Except when civil labour is available, units will as far as possible construct the entrenchments they*

are to hold. Engineer field companies will be employed to the best advantage under the orders of the divisional commander. They may be given separate tasks, such as the construction of obstacles of a technical nature, communications, observation posts, or the improvement of the water-supply, etc., or be distributed to certain localities or sections of the defence.

2. **Reliefs.**—When making any but the smallest entrenchments, men are not kept continuously at work, but are changed at intervals. The total time is thus divided into periods called *reliefs.* As regards the length of reliefs, a great deal depends upon the nature of the work, the total time it will take, the climate, and the condition of the men. This question of reliefs will also depend on whether the work has to be done at great speed, and whether it can be carried on by night as well as by day. For digging, short reliefs are best, and it will be found that a four-hour relief is as a rule quite long enough for anyone but a trained sapper. With reliefs of two hours or less, time is wasted in handing over the work, tools, etc., from one party to another, unless the organization is very good.

3. **Rate of Excavations.**—With full-sized tools the average untrained soldier should excavate in ordinary easy soil the following volumes in each hour :

1st hour	30	cubic feet.
2nd ,,	25	,, ,,
3rd ,,	15	,, ,,
4th ,, and after, up to 8 hours	10	,, ,,

or 80 cubic feet in a four-hour relief.

If the soil is very easy these rates may be increased, and *vice versa;* and if two men are detailed to each set of tools these rates may be multiplied by ½. These rates hold good for a maximum horizontal throw of 12 feet, combined with a lift out of a trench 4 feet deep. When the distance that the earth has to be thrown to deposit it in its final position is more than 12 feet, shovellers will be necessary as well as diggers.

4. **Tools.**—The proportion of picks to shovels will be decided according to the nature of the soil. In ordinary easy soil the entrenching implement is almost equal to a pick for loosening ground. In moderately hard ground containing stones a good proportion of tools (excluding the entrenching implement) is found to be 110 shovels, 55 picks with 60 helves, and 10 crowbars per

100 men, working continuous reliefs up to a total of 40 hours. This proportion gives sufficient spare tools to enable defective ones to be rejected.

In changing reliefs at the works, it should not be necessary to collect the tools in use if the men of the new relief are properly detailed to relieve the men of the old relief individually, after previous observation and instruction, and if the relief is carried out gradually.

5. **Spacing of Men.**—For continuous open trench-work, such as communication trenches, the normal distance apart at which men are spaced for work is two paces (5 feet). No practical increase of speed in execution can be obtained by reducing this spacing, unless it is not intended to make use of the full-sized pick. In this case men can work at 4 feet apart. *In the case of fire trenches all questions of mechanical spacing and distribution must give way to the selection, on the ground, of the best firing-point for each available rifle.*

6. **Task-Work.**—For instructional purposes task-work may be found better than time-work ; but *in the presence of the enemy men must work to the utmost limit of their powers during the whole of the time for which they are detailed for duty with a relief.* In calculating tasks, it is better to under-estimate than over-estimate the men's powers, in order to avoid incomplete tasks.

7. In arranging tasks, the following rules should be adhered to :

(i) The task of the first relief should be larger than those of succeeding ones, as the diggers have less distance to lift the excavated earth.

(ii) If possible, the men of each relief should leave a vertical face of earth for the next relief to commence upon.

(iii) All diggers should commence on the left of their tasks, in order not to interfere with one another, and, in continuous trench-work, should break into the task on their right.

8. **Organization of Working Parties.**—Care should be taken in arranging the preliminary details of working parties so that the men may arrive at the site of their work provided with tools, and in such formations as will admit of easy distribution to the works, which should be clearly traced in advance.

9. **Tracing.**—This tracing consists in laying out so much of the plan on the ground as is necessary to guide the distribution of the

working parties. It may be done by spitlocking or by laying tapes, but in the case of fire-trenches a picket or stone should also, when possible, be used to indicate the firing-point for each rifle for the use of which cover is to be provided. In hasty defence-work tracing with a tape is usually only necessary for night work.

10. **Tool Depôts.**—During the execution of defence-works temporary field depôts for tools and materials will be formed as close as possible in rear of each group of works. All tools not in use, and all materials not collected or delivered on the site of the works, or requiring special preparation, should be received, prepared or repaired, and issued at these depôts only.

11. The site of such a depôt may often correspond with the position of the shelters eventually provided for the supports to the fire-trenches, and it should be close to communications practicable for transport. Cooked food, water, shelter, and latrines for men of the working parties should be provided at each depôt, and messages intended for the superintendent of the works will be delivered to him there, or to the person detailed by him to take charge of the depôt and forward such messages.

12. Before the arrival of the working parties, and on the conclusion of the works, tools will be laid out at the tool depôt, according to the detail of the several parties previously communicated to the person in charge of the depôt, in heaps about 10 paces apart, the men filing between the heaps and receiving or depositing the tools as they pass. Arrangements will be made that all tools issued from the tool depôt are sharp and serviceable. The pick is carried in the left hand ; the shovel in the right.

13. **Distribution of Working Parties.**—Working parties should be requisitioned in actual numbers of men required, and should be detailed from the same company, battalion, brigade, or division, and not employed in mixed detachments. In calculating their strength, a reserve of one-tenth should be included. Unless otherwise ordered, all ranks will proceed to their work fully armed, accoutred and rationed. If the party is a large one and the work of a complicated nature, the men should be divided into detachments corresponding to definite portions of the work, each detachment under an officer or N.C.O.

14. Working parties should be distributed by one of the following methods :

(i) Each party, having first extended to the required interval at a suitable distance in rear, is advanced and halted on the line of the proposed excavations, while an officer details each man to his task.

(ii) Each party is halted in column about three paces in rear of one flank of the proposed line of excavations, and formed in file or single rank according as one or two men are allotted to each task. The officer who has marked out the works then explains each task to the men as they arrive : the men moving off, wheeling to the right or left as the case may be, and forming up in succession on the alignment.

In either case a man, having marked out his task with a pick, places it on the left of his task, takes four paces to the rear, grounds arms, removes his accoutrements (see para. 17 below), and lies down till ordered to commence work.

15. No work must be commenced till the distribution of the whole of each party is complete, as it is difficult to remedy mistakes when work has once begun. The subsequent shifting of men invariably tends to confusion, loss of time, and possibly of tools, clothing, and accoutrements. In cases where it has been impossible to reconnoitre the ground and actually site the works by daylight, and to avoid confusion and noise, it is better to divide up night working parties into squads, and to construct short lengths of trench rather than to attempt to dig long ones.

16. The commander of each squad must see that the proper alignment is maintained, and for night work should be provided with a tracing tape or rope divided into task lengths by pieces of white paper or cloth. He may also mark the ground with paper about 30 yards in front of the trench, to insure the lines of fire being kept low. For extending men for night work, the second method described above is the better ; but the normal interval may be slightly increased to prevent men striking each other.

17. If a sudden attack is likely to take place, *the rifles and accoutrements of all parties working in fire-trenches must be within reach, without necessitating the men leaving the cover of the trenches.* Superintendents, supernumerary numbers, and the reserves of working parties, must be detailed to their exact posts and duties in case of a sudden emergency requiring the use of defence-works in process of construction

18. Working-Party Table.—The following form of entrenchment and reconnaissance report may be useful to facilitate *rapid commencement of work*, and to insure that *men and tools are employed in the most advantageous manner :*

WATLING RIDGE POSITION, NO. 2 SECTION (13TH INFANTRY BRIGADE) 1ST SCOTS FUSILIERS.

1	2.		3.	4.	5.	6.
Task. (1″ Map Sheet 384.)	Men.		Tools required.	Tools with Unit.	Balance to complete.	Remarks.
	No.	From—				
1. East of HEXHAM COPSE at foot of slope (near rusty plough). Two 40-rifle trenches, 18″ command, traversed, recessed, and with head cover. Soil easy. Will probably take 7 hours.	80	C Co.	40 picks.* 80 shovels.	40 80	— —	
2. HEXHAM COPSE. Clear. Brushwood and small trees. About 8,000 square yards. Some brushwood required for trench above.	90	A Co.	10 felling axes. 70 bill-hooks or handaxes.	10 49	— 31	*1st Dublin Fusiliers.*
3. West of NORTHAM FARM at foot of slope (cleft stick and paper). Two 30-rifle trenches, 12″ command. Soil very difficult. Probably take 8 hours.	60	B Co.	60 picks. 60 shovels.	60 60	— —	
4. Communication trench from above trenches to east of NORTHAM FARM. 200 yards. Soil difficult.	120	D and E Cos.	120 picks. 120 shovels.	51 86	69 34	*Use grubbers; none available. 20 only Brig. Res.*
Etc., etc.						

It would as a rule only be applicable to cases in which it had been possible to send on officers in advance of the force to reconnoitre and report on the position to be held and upon the principal defensive works required. No fixed times have been given for the completion of the works, as this will depend so much upon the tools available. Should any second reliefs be found necessary, a redistribution of tools and a fresh supply of labour can be arranged during the first relief.

V. DIRECTIONS FOR WORK OF A SAPPING DETACHMENT*

1. A detachment or gang for driving an approach trench by sapping consists of a N.C.O. or ganger and eight men. The eight men are divided into two shifts of four men each, and only one shift works at a time. The other shift is nominally resting close at hand, but is actually ready to replace casualties or weak men in the shift which is on duty. A reserve of men, calculated at a third shift of four men per detachment, should also be kept within easy call.

2. **Task-Work.**—Task-work is always allotted to the ganger—that is to say, with his eight men he arranges as best he can to keep four of them at work at utmost speed until he has cut forward a certain length of approach trench. The length allotted is usually calculated to take his detachment from six to eight hours to execute, but if the ground is severe and the detachment likely to lose speed unduly from fatigue, a shorter length at discretion should be allotted.

3. **Changing Shifts.**—The ganger changes shift every time the working shift has cut and cleared an agreed length forward. In practice good progress is obtained by changing shifts at every 2 feet cleared. This should take about an hour in easy soil, and in that time a man who is fairly working to the utmost limit of his energy should scarcely be able to stand. Not a second must be lost between the order "down tools" to the old shift, and "carry on" to the new shift, who must be stripped to the waist and ready. The shift coming off must be rubbed down, warmly wrapped, and thoroughly restored before their turn comes on again; weak men must be ruthlessly discarded and replaced from the third shift, or put on to carrying and dumping the excavated earth.

* See p. 142.

4. **Work of Shifts.**—There are four jobs for each shift to keep going. (i) **No. 1** is the front man, upon whom everything depends for speed. His job is to break down soil straight ahead, which he usually does by undercutting on each fresh face until it falls. He should have a short miner's pick (handle 1 foot 10½ inches long) ; a short shovel (2 feet 6 inches long) ; a steel jumping-bar if there are are boulders to prize out, and an axe if there are tree roots to pass. He is only responsible for (*a*) keeping proper direction, (*b*) proper depth, and (*c*) full speed. The ganger is responsible for setting out direction and seeing that it is kept ; also for depth and rate of progress.

(ii) **No. 2** clears earth for No. 1, and stands just behind nim. He spreads a strip of canvas on the floor close up to the working face, so that the bulk of the earth cut by No. 1 falls on to

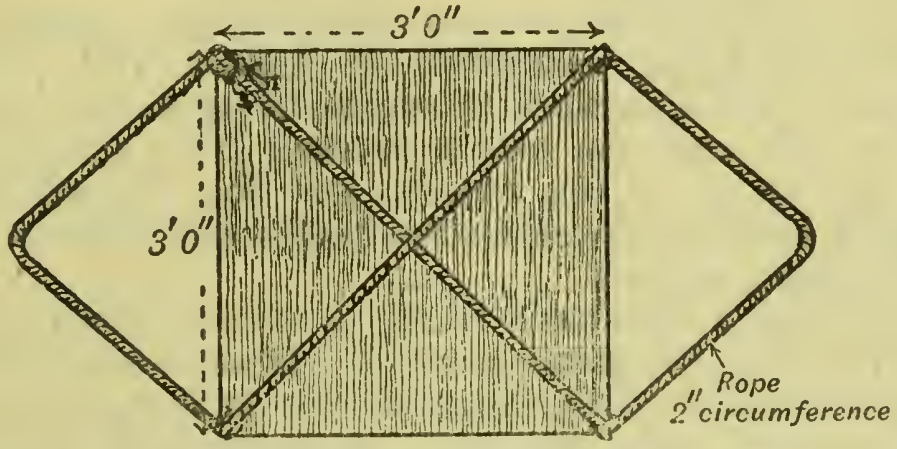


Fig. 86.—CANVAS STRETCHER FOR CARRYING EARTH (UNDERSIDE).

it. When No. 1 is ready to have it cleared, which he shows by "standing up" with his feet dug into the sides of the trench, No. 2 drags away the canvas, quickly scrapes back all other loose stuff with an earth scraper with a 3-foot handle and blade 12 inches wide, and spreads a fresh canvas. While No. 1 is breaking down the next lot, No. 2 shovels loose stuff into whatever receptacles are available for removing it to the dumping spot, and it is carried away and disposed of by unskilled labour, which is arranged independently for this service by the officer in charge of the approach-works.

From four to six men per sap will be required for this service. A square of canvas strengthened with rope, as shown in Fig. 86,

forms a good stretcher for removing earth, a pole being passed through the loops. Nos. 1 and 2 exchange duties halfway through the shift.

(iii) **No. 3** has somewhat similar duties to No. 1. His job is to widen the approach trench by about 2 feet until it measures 3½ feet at the bottom. This he does on the side which lies farthest from the enemy. He follows up No. 1 at a distance not closer than 9 feet from the head of the sap. His job is not so difficult as that of No. 1, and he has time to trim out the approach to full size. He requires a pick and a shovel, and occasionally a crowbar.

(iv) **No. 4** shovels for No. 3. Requires a shovel only, and fills the receptacles for removal by the carrying party. Nos. 3 and 4 exchange duties halfway through the shift. Next time the shift comes on duty Nos. 3 and 4 exchange duties with Nos. 1 and 2, and work at the sap head.

5. (i) The above arrangements require slight modification when the earth is not being sent away for disposal out of sight, but is thrown up to form a parapet between the approach trench and the enemy. In this case the two shovellers (Nos. 2 and 4) throw the earth straight up out of the trench, and No. 4 requires a scraper with a 7-foot handle to regulate the height and shape of the parapet without exposing himself.

(ii) Nos. 1 and 2 also have to move forward the steel shields or sand-bags forming the head parapet. If sand-bags are used, they are pitched forward to the front of the heap one by one as they fall in. A special "sand-bag fork" is used for this purpose.

Refuges or Returns.—Short lengths of trench should be cut out at right angles to the general line of each approach trench at frequent intervals, to serve as refuges or shelters for shifts awaiting duty, tools, water, etc., and for trench latrines, for it must be remembered that men will be working continuously in these sunken passages for many days, perhaps weeks, and the main passages must be kept quite clear for traffic. If the approach is formed as a series of zigzags with sharp turns, it is usual to extend the new or forward branch backwards for about 10 yards past each corner to form one of these refuges or returns, as they are called.

VI. TABLE OF MEN, TIME, AND TOOLS*

Required for the Execution of Certain Field-Works.

Note.—Except where otherwise stated, the material and tools are assumed to be on the site of the work. All tracing and marking out is to be done before the distribution of the working parties at the sites. Not more than five minutes should be consumed in distributing the men or in changing reliefs, if the men have been told off into suitable groups or parties under leaders previously instructed in the nature of the particular works in hand. One leader or foreman can conveniently supervise up to twenty unskilled men on earth-work.

No.	Nature of Work.	Minutes of One Man.	Per Unit of Task.	Suitable Unit Party.	Tools per Party.
	Entrenching.				
1	Excavation only ...	3	1 cubic ft.	1	1 shovel and 1 pick
2	Ditto, in small recesses, shelters, etc.	9	1 cubic ft.	1	Ditto
3	Shovelling loose earth	1	1 cubic ft.	1	1 shovel
4	Removing 50 yards (average) deposit, and return	1 2	1 cubic ft. 1 cubic ft.	1 2	1 barrow 1 stretcher
5	Filling sand-bags	3	1 sand-bag	3	2 shovels
6	Head cover, sand-bags or sods	60	1 loophole	1	1 shovel
7	Overhead cover, added to head cover in a recess	60	1 rifle	1	1 shovel, 1 hand-axe

* This table is taken from Appendix II. *Manual of Field Engineering*, much abbreviated. The times given are only for use as a very rough guide from which to estimate a probable rate of progress under favourable conditions. For hourly rates of excavation see p. 201.

No.	Nature of Work.	Minutes of One Man.	Per Unit of Task.	Suitable Unit Party.	Tools per Party.
	REVETMENTS.				
8	Brushwood, rough or planks	1½	1 sq. ft. (revetted)	2	1 bill-hook, 1 mallet
9	Sand-bag or sack	3	1 sq. ft. revetted	2	—
10	Sods, building with	6	1 sq. ft. revetted	2	1 shovel or spade
11	Sods, provision of (for above)	9	1 sq. ft. revetted	3	3 sharp spades
	CUTTING AND FELLING.				
12	Trees, felling, up to 12 in. diam.	1	1 in. of diam.	1	1 felling axe or saw
13	Woods, clearing of brushwood and small trees	2½	1 sq. yd.	20	10 bill-hooks, 4 felling axes; 4 hand-axes, 2 saws; 1 grindstone, 2 whetstones
14	Hedges (felling stems)	10	1 yard run	2	1 bill-hook or hand-axe; 1 saw, 3 fathoms rope
15	Brick wall, notches in, up to 18 in.	10	1 notch	1	1 pick, crowbar, or mason's chisel and hammer
16	Brick walls, loop-holes in, up to 18 in.	30	1 loophole	1	
	OBSTACLES.				
17	Abatis, and wired (one strong row)	120	1 yard run	20	As for item 13; also 2 mauls, 3 pair pliers, 1 pickaxe, 1 shovel
18	Wire entanglement (Fig. 76)	60	1 sq. yd.	3	1 bill-hook, 1 hand-saw, 1 maul, 1 pair pliers, 1 pair wire-cutters; 3 rag pads for gripping and straining wire; *In hard ground add:* 1 steel jumper, 1 sledge-hammer

MATERIALS.—Allow for posts about 2 yards apart, also pickets for side-stays to outer rows, and 30 to 50 yards of wire for every post driven. Ordinary stout barbed wire runs about 500 yards to the 1 cwt. reel.

DIAGRAM

To illustrate conventionally the Auxiliary Works required to prepare a Fire Trench for occupation and use (not to any Scale)

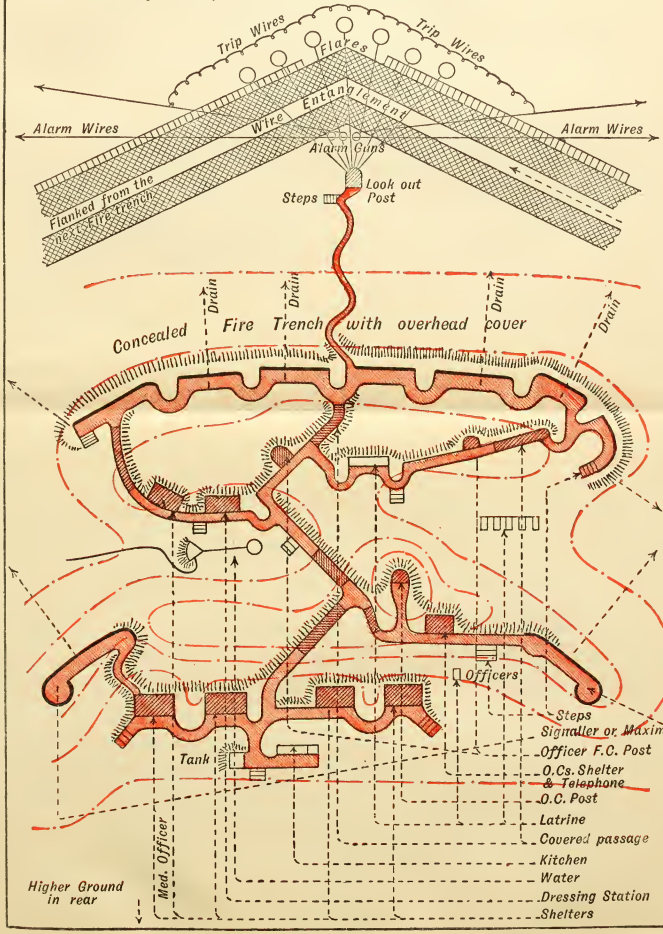


Fig. 87.

To face p. 211.

VII. SUMMARY OF GENERAL POINTS

WHICH MAY REQUIRE CONSIDERATION IN CONNECTION WITH THE CONSTRUCTION OR OCCUPATION OF ENTRENCHMENTS, IN ADDITION TO THE USUAL FIELD TACTICAL DUTIES APPLICABLE TO TROOPS ON OUTPOST DUTY.

(*The order of importance is a matter for local decision.*)

Figure 87 gives, as a diagram only, a pictorial reminder of some of the auxiliary works required in connection with deliberate entrenchments. Parapet shelters (see Fig. 71) are not indicated, but should be added if possible. Fire-trenches arranged so as completely to enclose a small island of ground are known as a "closed group" or redoubt. The actual fire-trench need not be continuous around the enclosure, but there should be continuous communication-trenches throughout and between all parts, and ample alternative shelters for the maximum garrison. The obstacle should also entirely enclose the group, except for the necessary entrance on the least exposed side. The group should be shallow from front to rear. A strong general shape or trace for such a group or redoubt will often take the form of a dumb-bell or pair of spectacles—*i.e.*, two small ring enclosures at the ends or flanks, and a good long frontal fire-line connecting the two.

Look-out Posts and Reconnaissance.—(1) In advance of general firing line. Protection for the back of advanced look-out men, and means of communication with commander.

(2) Arrangements for picking up signals from all quarters by night and day.

Firing Lines.—(1) Concealed fire-points for day use, complete with shelters.

(2) Overhead cover, back cover traverses, and recesses.

(3) Alternative fire-points. Allowance for possible reduction or increase of number of rifles originally provided for.

(4) Allowance for severe shell damage to fire-points; reserve parapets behind parados.

(5) Fire-points for night use; contracted firing line.

(6) Special fire-points, not exposed to frontal fire, to be used for enfilading dead ground and obstacles at close ranges.

(7) All-round defence, and key fire-points which can dominate and control the outlying or alternative fire-points provided for the fully expanded firing line.

Machine Guns.—Alternative fire-points prepared for, complete with shelters for machine gun detachments close at hand, and easy communication with the guns.

Concealment.—General arrangements for, including obstacles.

Communication.—(1) Screened intercommunication tracks or trenches chosen, and directions marked for night use between our own fire-points, shelters, and supports.

(2) Main roads or communications for reserves and supplies.

(3) Transmission of orders, ammunition, and supplies.

(4) Removal of wounded while the works are under fire.

(5) Position of nearest supporting and reserve troops.

(6) Communication with adjacent rifle groups and posts.

(7) Agreed method of borrowing or lending cross-fire, and exchange of general local information.

(8) Communication with General Headquarters.

(9) Telephones. Signalling apparatus.

Artillery Support.—(1) Positions of, and good communication with, supporting artillery.

(2) Agreed method of description of localities on rifle foreground, and maps compared.

(3) Consideration of possibility of bringing up field guns into the rifle-firing lines.

Fire Control.—(1) Selection and preparation of cover at the best points for control, direction, and observation of fire by officers and fire leaders.

(2) Arrangements for directing and controlling fire at night.

(3) Telephone, megaphones, rockets, and signal lights for informing artillery, etc.

Improvement of Foreground.—(1) Spoiling cover for enemy on foreground.

(2) Improving foreground for our own fire.

Ranges.—Range-finders. Ranges taken, marked on foreground, and in possession of all fire leaders. Range cards or lists.

Next Advance.—(1) Steps and exits for quitting and rapidly advancing from present firing lines to next firing line ahead.

(2) Lines of advance chosen. Exact intermediate cover and firing-points to be seized, and by whom.

(3) Which of present fire-points to be used to cover next advance.

(4) Agreement with adjacent works and artillery for co-operative action.

(5) Arrangements for next fire entrenchments.

(6) Extension of present communications.

(7) Flags to plant on new ground to indicate progress to supporting artillery.

Obstacles.—(1) Arrangement and provision of, and complete control by fire at ground surface level.

(2) Openings through obstacles, whether to be closed at night—how and by whom.

Alarm Wires.—Arrangement and provision of ; to be adjusted and set, when and by whom.

Lighting Foreground and Communications; Direction Signs in Passage Trenches.—Arrangements for, and by whom attended to. Arrangements for asking for light on particular foreground.

Shelters. — (1) For wounded; first-aid dressing stations; stretchers.

(2) For those awaiting treatment ; seats.

(3) For those awaiting removal.

(4) For commander and telephone.

(5) For officers and fire-leaders.

(6) For telephone orderlies, signallers, and messengers.

(7) For all others, small, numerous, well dispersed, but close to their work.

Signalling.—Arrangements for night and day work. Coloured lights and rockets.

Sanitation and Food.—(1) Receptacles for water storage; distribution of water ; replenishment of food and water under fire.

(2) Provision of fuel.

(3) Provision of dry materials for spreading under foot in trenches, shelters, etc.

(4) Drainage in wet weather.

(5) Latrines for use by men while :

(*a*) Under fire.

(*b*) Not under fire.

(6) Cooking-places and feeding arrangements :
(*a*) When under fire.
(*b*) When not under fire.
(7) Frequent disposal of refuse.
(8) Arrangements for washing when possible.
(9) Disposal of dead.

Arms and Equipment.—(1) Preservation of surplus arms and equipment.
(2) Storage and distribution of ammunition.
(3) Arrangements for destruction or burial in emergency.
(4) Hand-grenades : distribution and storage.

Tools and Materials. — (1) Arrangements for collecting additional materials.
(2) Arrangements for repairing shell damage to works and obstacles.
(3) Arrangements for continuous improvement of fire position and communications.
(4) List of improvements still required, on change of command or favourable opportunity.
(5) Arrangements for filling reserve of sandbags.
(6) Arrangements for burying tools and other stores, and destruction of shelters in emergency.
(7) Sharpening and repairing tools.
(8) Lists of tools and materials to be sent up from the rear.

Watch Dogs.—For sentry work, provision of.

Miscellaneous.—(1) Ammunition distribution, and maintenance of reserve.
(2) Gongs or signal bells.
(3) Dummy works, guns, sentries, etc.
(4) Agreement of watches or clocks as between adjacent works and artillery.
(5) Naming and numbering of fire-points, shelters, etc.
(6) Names agreed with neighbouring troops for unnamed features.
(7) Wire loops for rifles, and pegs for hanging up spare clothing, etc., at fire-points and in shelters.
(8) Standing orders. Inclusion of instructions connected with care of arms, current inspection, improvement, and maintenance of the works, and the routine duties incumbent upon each rank concerned.
(9) Alarm orders : every officer and man to know his exact post and duties.

(10) Units to supply orderlies in attendance on commanders.
(11) Precautions for extinguishing fires.
(12) Prohibition of use of wire entanglements for airing clothing, blankets, etc., or otherwise betraying the nature of the occupancy of the works.
(13) Consideration of special action necessary to relieve pressure on adjacent posts.
(14) Rallying-points in the event of withdrawal. Every man to know where to report himself if lost.

VIII. NOTES ON EXPERIENCE GAINED AT THE FRONT

By the Author.

1. *It is important to note that the broad principles of training laid down in the official Training Manuals on which the British Army has been trained—including the instruction contained in this book—are defined by a General Officer at the front, after the test of war experience, as sound, and the need of paying strict attention to them in carrying out training is strongly emphasized.*

2. These notes, therefore, do not affect the general principles of training laid down in this book. *They merely deal with the application of these principles to the peculiar conditions which have so far obtained in the course of the campaign.* These conditions may at any time give place to others, for it must be remembered that in no two military operations is the situation exactly the same. *Instructors, therefore, must avoid the mistake of training their men for any particular given conditions of warfare, and remember that general principles and broad rules alone are applicable to the leading of troops in war* (*Infantry Training*, 1914).

3. Screening Defence Works.—*The Importance of Screening Defence Works from the View and Fire of the Enemy's Artillery* (pp. 6, 7, 10, 119, etc.).—This often tends to the selection of sites for fire-trenches *behind* rather than in front of the crest line of a slight ridge, provided that a sufficiently clear field of fire can be obtained to deal with infantry advancing in force. The extent of foreground mentioned on pp. 6-7—*i.e.*, 300 to 400 yards—will

usually be found ample; and a still shorter foreground is often considered sufficient by trained troops, provided it is clearly commanded from the firing-points, and is strengthened by a good obstacle which would also, in such a position, be well screened from the distant view of the enemy.

4. Visible Parapet.—As far as possible visible parapets (pp. 9, 58, and Fig. 28, etc.), should be dispensed with.

5. Width of Trench and Firing Step.—Trenches should be deep, and as narrow as will permit of free movement. Firing steps, if firmly riveted, may often be reduced in width to 12 or even 9 inches, if the toes can be dug forward into the interior slope (pp. 59-60, etc.).

6. Traversing and Firing Recesses.—Traversing should be carried out at frequent intervals—say every four or five yards on the average; and firing recesses made where a trench is likely to be exposed to enfilade fire. Special traversing should be carried out at salients (pp. 61-73, etc.). Useful arrangements of fire-trench are illustrated in Figs. 31 and 36 (*D*).

Plenty of small recesses should be provided, both in fire and cover trenches, for shelter from shrapnel and splinters (pp. 48, 95, etc.). Protection against heavy shell is unobtainable, but the effects can be localized by good traversing (pp. 88, 115, etc.). Undercut recesses in weak soil require to be carefully shored up.

7. Head Cover and Overhead Cover.—Head cover and overhead cover in the cover trenches is valuable, but overhead cover *in the firing-line must be used sparingly if it will interfere with the rapid use of the bayonet when no obstacle intervenes between opposing trenches at close quarters.* Where head or overhead cover is provided in the front firing-line, it is important to have independent support trenches immediately in rear, from which a clear shot can be taken at close quarters at an enemy who is trying to close with the front line (pp. 74, 92, etc.). At night the bayonet only must be relied on, as supports must not shoot into their firing-line.

8. Communication Trenches and Shelters.—Communication trenches for the passage of supports and supplies are important (p. 151, etc.); cover trenches are required to be close up—say 15 to 25 yards in rear of the fire-trenches—with shelters in which men can sleep (pp. 94, 98, etc.).

9. Concealment.—All earthworks must be assimilated to surroundings (pp. 9, 118, etc.).

10. Elbow Rests.—The value of elbow rests is not generally found to outweigh the importance of good cover close to the shoulder (p. 49).

11. Siting Trenches at Night.—It is important to insure a good field of fire when siting trenches at night. An electric torch sent on ahead to point back at the firing-points will be found useful (p. 61, etc.). Digging is nearly always done at night, and requires previous training and practice to carry out efficiently.

12. Co-operation of Infantry and Artillery.—Good communication and co-operation between infantry and artillery in defence is important (p. 161, etc.).

13. Dummy Trenches.—The use of dummy trenches, etc., is valuable to distract attention from true positions; also advanced or buffer trenches lightly manned by snipers, look-out men, etc. (pp. 5, 121, etc.).

14. Illumination of Foreground (pp. 186-187).—(1) No fixed apparatus can be set in the field for the reliable lighting of foreground at night which will survive a prolonged bombardment and bad weather, or admit of renewal or attention in the close presence of the enemy. This does not apply to electric searchlights employed in carefully chosen and protected sites in connection with harbour and fortress defences, nor to flares or bonfires set for the purpose of providing a single illumination for a given purpose, such as a signal or landmark. (2) For the temporary illumination of foreground during an engagement with the enemy, a good method is to employ hand and rifle "illumination grenades" which ignite on impact with the ground, upon the same principle as in the detonation of the percussion hand and rifle grenades. By this means temporary illumination can be concentrated at the exact points at which it is most required. In siege warfare or trench fighting at close quarters there is special use for a combined incendiary and illumination bomb or grenade fired from a trench mortar. These bombs would be charged with inflammable and illuminating material and liquid, together with a small charge of explosive, which would ignite and scatter the contents freely upon impact.

15. Machine-Guns (p. 93).—A Maxim on tripod mounting requires

a platform of earth measuring about 4 feet square, and sunk about 12 to 18 inches. On the right-hand side and in rear of the platform a trench 2 feet wide may conveniently be cut to a level 3 feet below that of the platform, and leading to the detachment shelters and the general communication trenches. Since machine guns are usually employed for flanking or enfilade fire, good traverse protection is necessary on the exposed flank.

16. Obstacles.—Portable obstacles may be usefully employed for the temporary closing of roads, gaps in wire entanglements, etc. These may suitably consist of a framework of wood, etc., caged round with barbed wire. In the case of roads a heavy tree, pivoted at the point of balance and mounted on rollers, with a wire fence added above the trunk, forms a good motor-car stopper. Heavy motor vehicles run at speed may assist to clear road osbtacles and barriers. Steel grapnel-hooks fired from a whaling harpoon-gun, then hauled from a distance with a power-winch, may assist in clearing portions of wire entanglements. Obstacles which are more than 30 yards in front of a fire trench are difficult to control by frontal fire in the dark (pp. 172-182).

17. General Development of Fire-Trenches on a Large Scale in Close Contact with the Enemy (p. 7, etc.).—Owing to the varying stages of progress by units in their advance, fire-trenches executed in the close presence of the enemy usually assume at first a disposition in irregular lines and echelons, with intervals. These receive gradual adjustment as regards alignment until one strong line of entrenchments is obtained. Such a line consists partly of fire-trenches and partly of communication trenches linking up with the adjacent fire and support trenches. The tendency in course of time is to cover the entire frontage with a nearly continuous labyrinth of trenchwork somewhat similar to Fig. 87 (p. 210), with the addition, in many cases, of hundreds of yards of "approach" communication trenches from the nearest covered ground in rear of the position. Some of these approach trenches can often be prepared to act as flank fire-trenches in case of local penetrations of the front line. Close behind these main lines of entrenchments supporting points, consisting perhaps of fire trenches, or closed groups of trenches, with intervals, are added at distances from 50 to 200 yards or more in rear of vulnerable points, as an insurance against a local penetration of the fore-

most line. Farther back would be found the artillery positions, and many successive deliberately prepared lines of resistance.

18. Additions to Appendix II. (pp. 193-196). — Some types of artillery in use by the German Army are given below—

(i) **Field Guns.**—15-pounder (1896), mounted on a shielded gun recoil carriage. *Calibre*, 3·03 inches. *Time fuse* ranges up to 5,500 yards. *Percussion fuse* ranges up to 9,186 yards. *Rate of fire*, up to 20 rounds a minute. *Shrapnel* contains 300 bullets (45 to 1 pound). *High explosive shell* contains 7 ounces of nitro-powder, with fulminate detonator. *Rounds*—per gun in the battery—132.

(ii) **Light Field Howitzer** (1909).—*Calibre*, 4·13 inches. *Time fuse* ranges up to 5,800 yards. *Percussion fuse* ranges up to 8,100 yards. *Weight of shell*, 31 pounds. *Universal shell* (combined shrapnel and high explosive) contains 500 bullets (42 to 1 pound) and 5¼ ounces of picric acid, with fulminate detonator. *Rate of fire*, up to 6 rounds a minute. *Rounds*—per howitzer in the battery—91.

(iii) **Heavy Field Howitzer** (1902).—*Calibre*, 5·9 inches (15 centimetres). *Ranges* up to 8,150 yards. *Weight of shell*, 89 pounds. *Bursting charge*, 11 pounds. *Rate of fire*, up to 3 rounds a minute. *Rounds*—per howitzer in the battery—72.

(iv) **Heavy Field Mortar.**—*Calibre*, 8·27 inches (21 centimetres). *Ranges* up to 8,400 yards. *Weight of shell*, 262 pounds.

(v) **Heavy Siege Howitzers**—

Calibre, 11 inches (28 centimetres). *Range*, 12,000 yards.
„ 12½ inches (32 centimetres).
„ 16½ inches (42 centimetres).

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